SUPPLEMENT.

The Mining Journal,

RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

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Original Correspondence.

MINES AND MINERALS OF AMERICA—No. XVI.

SANDSTONE COPPER MINES.

Sir,—In concluding for the present our description of this class of mineral property, we will shift the locality about 100 miles to the south-west, where we shall enter the state of New Jersey. On the edge of an extensive morass, seven miles from the city of New York, known as the Jersey flats, and chiefly proverbial for its ague-breeding atmosphere, musquitoes, rattlesnakes, and mud turtles, rise a low range of hills, composed of new red sandstone. In their vicinity are several prominent bosses of trap, and further northward many of the elevations are entirely covered with this rock. On the Passaic river (a tidal navigable stream flowing through those marshes) some of the lower beds produce the finest building-stone found in this country, and commonly called freestone; it is of a light red and grey-brown colour, smooth grained, compact, and very durable. Extensive quarries of this material are worked at Belleville, Little Falls, near Paterson, and other places, from whence it is shipped to New York, where it finds a ready market, and is used for the finer kinds of masonry. These strata, which are nearly horizontal on an average for some miles, although subject to local dips and elevations, alternate with beds of shale and conglomerates, the latter nearly always containing metallic minerals. Elvan, or trap-dykes, are found in many places severing the strata, but without altering their continuity, or changing the nature of the stone, a prominent instance of which may be seen in the Oldham Quarry.

Two miles from the picturesque village of Belleville are the Schuyler Copper Mines: they have been worked by different parties several times during the past 50 years, but never until recently with any apparent success, and we are not positive that even now they are made to pay for their prosecution. About four years since we made a professional visit to this particular mine, in company with some of the proprietors, when we found that a most excellent engine-shaft, some 20 fms. deep, had been sunk by a former party of adventurers, with an adit level driven up from the moors to intersect it. The foundations of the old engine-house are still remaining, from which it could be seen a horizontal engine had been employed to assist the sinking of the shaft and draw the stuff. We were informed this work had been done by an English and Philidelphia Company, but whoever the parties were it gives evidence of being executed in a miner-like manner. An old resident of the neighbourhood testifies that at the time the workings were suspended the extreme ends were in a fine course of ore of a very rich quality, and much superior to the ore now being raised nearer the outcrop. Not being able to penetrate these old workings on account of the fallen debris, we could not judge of the value of the ore *in situ*, but an examination of the rubble pile convinced us they had passed through a highly mineralised piece of ground. We found numerous pits and old burrows, some of which, although filled in, gave positive indications of being air-shafts to the shallow workings. Many of the old burrows, from their appearance, must have been thrown up 100 years ago at least, and that extensive works had been carried on many years anterior to those when the modern engine-shaft was sunk.

The present proprietors at the time of our visit had cleared up one of the old shallow shafts, and were working in the old ends. There are here two distinct beds of mineral, only a few feet apart; the upper one is about 5 ft. thick, composed of soft light grey sandstone, streaked similar to a block of vein marble, but in blue and green colours. The stone has a most beautiful appearance when fresh broken, and would make a Cornishman's eyes sparkle to see it, for it is thoroughly impregnated with carbonate and silicate of copper. It gave on the vanning shovel 2 per cent. of ore of a very high produce, but as it is impossible to prevent the light carbonates from floating off with the water in vanning, and not having any apparatus at that time to ascertain the actual quantity of copper in the stone by a humid assay, we could not determine its positive yield, but we felt quite certain that if a liquifying process were brought to bear on the mineral in large quantities it would well repay manipulation. The next bed is a conglomerate, and varies from 2 to 7 ft. thick; it is an irregular deposit, and, although a continuous plane, is not so easy to work as the upper bed, on account of its inequalities. It is composed of fragmentary rocks of several kinds, which are formed both rounded and angular. This deposit bears ample evidence of being the result of an extensive drift, for its erratic constituents are not confined to the rocks of the immediate vicinity. They are partly of marine origin, and no doubt were thrown up as shingle when New York Bay was an estuary of far greater extent than at the present time. It contains round, amygdaline, and amorphous pebbles of quartz, gneiss, slate, lime, and various sandstones, fragments of trap, and shales; the whole cemented together at the outcrop with oxide of iron and clay, but interiorly by quartz, sand, clay, and iron, forming an agglutinated compact rock. In this deposit are found solid veins, flakes, lumps, and granules of rich grey and vitreous copper ore, interspersed throughout its entire mass. This ore can be easily extracted by stamping, and dressed in the same manner as tin.

Prior to our visit the company had made an attempt to work this ore by dry stamping and dressing with Bradford's patent separators, but which, on account of the great expense in working such machines, and the small quantity of ore returned, proved a failure, although they brought the ore up to 38 per cent. produce. Grates and water were next introduced to the stamps, and trunks and buddles took the place of the patent machines. The result was a much larger return of ore (time of operation being equal), but the yield 10 per cent. less in produce. The ores operated on were mixed, the larger proportion, however, being the mottled sandstone. The experiment was being conducted on such a limited scale as to give no criterion what would be the eventual result. We saw enough, however, to become convinced that hand buddling with a dresser receiving $1·37 per day, would never answer. We, therefore, recommend stamping on a larger scale, and dressing direct with circular buddles. The conglomerate produces a remarkably clean ore of 35 per cent. produce, chiefly sulphuret o copper. The iron floats off, but unfortunately carries the greatest part of the carbonates with it. We entertained an opinion at the time that some means could be devised for treating the entire bulk of the stamped stuff with a diluted acid first, which would render the carbonates and silicates soluble, and then from the decanted liquor precipitate the copper by the usual process. After which the stuff could go to the buddles, and all the ore be saved; but to recommend such a plan would be a costly experiment, the probable profit of which the writer had no antecedents to warrant him in doing. The matter now stands in a very different position to what it did then; he solution process is no longer experimental, for it is carried out extensively in many places in Europe, and there is no reason why what is done successfully in one country may not be done in another. Now, if this run of mines were prosecuted on a scale commensurate with their capabilities, excellent profits would be obtained.

The extent of country through which these cupreous deposits exist is not known: we found them for two miles along the edge of the moors, and have seen indications of the same formation in several places some miles distant in the same section of country, and from what is proved at the Schuyler Mine we conclude other spots are equally worthy of trial.

The company consist of New York merchants; they have expended a good deal of money, but most of it in experiments; this is always the case on this side of the water. They are, however, determined to go ahead, but, as the agent justly remarked, the mine is much too near New York. The directors make a hobby of the thing; not a day scarcely passes but one or the other of them are out there with their friends and numerous busy-bodies, so what with their different opinions, undue interference, and general impatience to see results, sadly retard the execution of any plan of operations, however practically conceived. Nevertheless, they well deserve success, and will eventually, no doubt, achieve it.

Mr. George Henwood's excellent article on the "Alderley Edge and Gourock Mines," published in the Journal on Jan. 10, would make them appear identical with those of New Jersey; it will be read with a good deal of interest, and eventual profit, by many owners of this class of mineral property in this country, and we entertain no doubt all will be very thankful to that gentleman for the valuable information therein given. In conclusion, let me say that the dissemination of practical knowledge, however hackneied it may be thought by the few who consider themselves perfect in all things, is highly appreciated in this country, from whatever source it may come; it is, nevertheless, true that much egotism prevails here, as elsewhere, for it is a prominent trait in the American character to consider himself "top sawyer" in all inventions and improvements. This feeling does not emanate from any peculiar self-reliance; it is the result of his early education. That he pertinaciously insists he is right, until convinced he is wrong, is a fact well understood by all who have dealings with him; but only show him a chance of gaining an advantage, even if it should come from an old countryman, and you will soon see how suddenly he changes; he becomes at once an inductive being, and is willing to be led where before he would only consent to be leader. Injustice is often done him through ignorance of his peculiarities; overlook these, and you will find him a "man more sinned against than sinning." The writer, who has had ten years' experience in North and South, has found much more to applaud than to censure. Individual instances have been met with of the meanest and most contemptible kind; but generally the American gentleman has been found liberal in his patronage to strangers, and generous in his friendship. It is from this, we repeat, that practical information on any useful scientific subject will ever meet with its admirers, and be received as *utile dulci* by a discerning community at large.

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MINES AND MINING IN MEXICO.

Sir,—The long series of civil wars that have taken place in Mexico, and the neglect in the formation and maintenance of roads shown by its successive Governments, added to the prevalent insecurity attaching to life and property, have tended not a little to discourage investments in Mexican mines. Since 1825, however, British enterprise has not ceased to be directed to the extraction of the argentiferous wealth of the country. No country in the globe has produced so much silver as Mexico; nowhere else have such vast individual fortunes suddenly accrued from mining enterprise. The Spaniard who, 98 years since, discovered the mine of Valenciana, shared profits with his partner, after a few years' working, of 250,000*l.* per annum; but the machinery was subsequently destroyed by fire, water was suffered to accumulate, and this promising mine is now in possession of an English company. The mineral resources of the country are well known, and although large sums have been lost, especially by German miners, in speculative enterprises, the security for obtaining satisfactory returns is increasing with the advance of practical science. A continual source of disappointment even in opening up old mines has come from under-estimating the preliminary expenses. No sooner is the shaft cleared than it must be timbered up, shrubs that had grown to trees having torn down the protecting sides; below the levels will be found covered with water, and the refuse heaps of old workings are intermingled with the water, and must at all points be carried off. The Great Barranca Mine entailed an expense on its former proprietors of more than 40,000*l.* per annum for the item of clearance alone. Persons unacquainted with mining operations cannot imagine the difficulties presented in putting things in order even in a modern mine that has been carelessly worked, so far as air and facility of access is concerned, or which has been suffered to go to ruin. Besides, during any suspension of operations the machinery at the mouths of the shafts is much damaged, and the plunderer makes his way.

The Capula Silver Mining Company has a mine in the district of El Chico, 65 miles north of the city of Mexico, on which some 10,000*l.* has been spent by a previous owner, who, although finding the mine in a ruinous state, was enabled at this cost to effect a communication between the adit and the shaft, and thus secure ventilation. The best ores of this mine have yielded to assay tests from 1600 to 2000 ozs. of silver to the ton; the common from 70 to 100 ozs. The operations at the Capula Mines commenced in May of last year, under very efficient direction. A considerable length of the adit level having been cleared, and about 300 fms. of the tramroad laid, operations for the clearance of the main shaft and removal of debris from other workings have been greatly facilitated. Several lodes have been examined, the ore of which will pay for extraction. At the surface store-houses, smithy, carpenters' shops, saw-pits, and cottages for the workmen have been erected, and a wall partly built to enclose the site intended for the reduction works. The preliminary expenses from Jan. 7 to Sept. 29, last year, were about 10,000*l.*

The states of Mexico, Guanaxuato and Zacatecas, are those in which the chief mines of silver are situate; the Zacatecas, Guadalazara, San Luis Patosi, Ocaxaca, Valladolid, and Sonora may also be pronounced rich. A considerable portion of the silver formerly exported to Europe was from the mining district of Themasaltepec, on the Pacific slopes of the wooded cordilleras of the Andes. Here may still be seen the remains of ancient haciendas for preparing the silver ore, aqueducts and rocky watercourses for supplying the ponderous machinery that pounded the ore, all overgrown with vegetation.

A certain advantage formerly possessed by mine proprietors in Mexico is wanting now, from the Rothschild's having secured a monopoly of the yield of the Spanish Almaden Mines—the chief source of supply. The price of the article, which might previously have been purchased for 1s. 9d. per lb. in London, has been raised in Mexico from $80 to $100 per quintal. Looking to the quantity necessary to be employed in amalgamation, this entails 12 per cent. reduction on the annual silver yield.

With a mine in working order, the sound of the blasting in the porphyritic rock, with its low rumbles and far echoes in the distant gloom, added to shining torches of candle wood, and the Rembrandt-like effect of the light on the misty forms of the miners, and the hollow echoes of their voices, and the incessant ringing of the pickaxes, the trituration of water, the crumbling sound of loosened earth and ore, with the general picturesque appearance of the subterranean domain following the curves or leaps of the ore, and with its chasms spanned by frail bridges that seem the pathways to impenetrable darkness, cannot fail to make a strong impression on the European visitor. Not only is as much as possible of the worthless rock cast aside underground, so as to avoid the labour of drawing it to the surface, but a division is made between the richer ore for smelting and the poorer for amalgamation. In the mining yard the two descriptions are yet more effectually separated, and undergo a dressing and cleaning process for the reduction works. Where the amalgamation works are at any distance the ore is packed in leather bags, carried off by asses or mules, the cargas and drivers being duly superintended. Appended to each parcel is a list of its number, as recorded at the mine, and against this is set the reputed quality of the ore. After being duly compared with the invoice, it undergoes the process of pulverisation.

In traversing the mining districts of Mexico, the evidences that present themselves are not few of the enormous and costly exertions of the Spanish conquerors to reach the stored wealth of its hills. Deep in a barranca, hemmed in by precipitous basaltic cliffs, from which leaps a mountain stream into the most beautiful and perfect basin of basalt in the world, thence flowing over a rugged bed of broken basaltic columns, is the celebrated silver mine Hacienda de Plata, in the formation of which half a million of money was expended. It shows the ruins of gigantic arches, which look as if they had been intended to support the world. Amidst these battered works very successful mining operations are carried on. The mines of Bolanos, situate along the eastern level of deep precipitous cliffs, appears to have presented a great attraction to English capitalists. The old workings have offered considerable impediments in the soft ground which has fallen in; for, though the veins for the greater part are in porphyry, these are intersected by strata of crumbling steatite or soapstone. The range of mountains to the west is clothed to the summit with fine firs; but, owing to the precipitousness of the mountain roads, it is almost impossible to transport spars of any magnitude. There are three sets of mines in the Northern Bando—that of Concepcion has its principal shaft far up the wooded hill, which has been completely cleared, whilst an old working that has been driven has successfully cut the lode. The mine of Tepec, contains the new shafts of Santa Fé, with two others of equal note. The new shaft of Santa Fé has been soundly timbered for 30 fms., but owing to the ancient shaft up in the mountains being choked, ventilation has been impeded, and drainage rendered difficult. The drainage of mines has not been left by the Real del Monte Company to maincates or even steam-engines, but it is extending the adit of its Biscana vein, which was already 2641 ft. in length when it came into their possession, and proved as profitable to the Conde de Regla, who in its course drove on another vein than that he was seeking, and was enabled to extract 80,000,000 of dollars.

One establishment will often have seven stamping or crushing-machines, each with nine mazos or stamps. To each molino, or ore crusher, are allotted eighteen mules, three at a time working abreast, for about three hours, and the rest being employed in rotation; three feeders of metal, and one or two mule drivers. Six stamping-machines only are put in use, one being held in reserve. At the great mines these machines work day and night. The *arreador*, or mule driver, sits at the end of his lever, and is blindfolded, to prevent any injurious effects from the dust. The granza, or crushed ore, thus pounded in the dry, is conveyed to the *tahonas*, or grinding mills: these are usually contiguous to the mines, and work for the same periods as the *molinos*. They consist of a bowl formed of unhewn slabs of porphyry, some 10 ft. in circumference and 1 ft. deep. Each *tasas* or bowl has a post rising in its centre, level with the brim, and mounted by an iron socket, in which traverses a timber shaft, 6 feet in height, and made to move on a spindle in the beam of the framework above. Crossing the shaft at right angles are two strong pieces of timber or spars; these project to the circumference of the rim, and to each is attached a large block of porphyry, so lashed to the spar as to move freely. Each block weighs from 600 to 800 lbs.; in 10 or 12 weeks they become unserviceable, from loss of weight. Two mules suffice to draw the *tahona*, which is frequently in operation 16 hours a day; in these 16 hours a *tahona* grinds 1000 lbs. weight of *granza* into *lama*, which is the fine paste prepared for the amalgamation-floor. The cost of a *tahona* is usually not more than 6*l.*, a sum about equal to the weekly wages of the one who has the charge and direction of grinding the ore, his assistant, and the *capitan de galera*, the person in charge of the sheds under which the tahonas are worked.

The average size of an amalgamation-floor is 350 by 250 feet; strong walls surround it, and the pavement is of porphyry. The *lama*, or ore ground into fine masses, is placed on this floor in circular masses, 7 inches deep, and of varying diameter, sometimes as much as 50 feet. The spaces occupied by these collections of paste have been previously enclosed by rough planks, backed with paving-stones, horse-dung, and dust, to prevent any escape of paste Salt is first applied to the different heaps, 50 lbs. being commonly allotted to every ton of ore; the salt rapidly blends with the mass; and in 24 hours the magistral is added, an ore of sulphuret of copper, mixed with iron, which has been roasted and pulverised, and is now applied to decompose the ores of silver in the process of amalgamation; the proportion of this magistral applied is 25 lbs. to the ton. Quicksilver, in quantity six times the estimated weight of the silver in the torta, is then sprinkled over the surface, through a coarse cloth, with earthy impurities: a second gathering, collected from swamps, and the saline quality of which is so slight that its presence is only to be detected by the taste. Great watchfulness is necessary on the part of the superintendent, who, from time to time, tests the progress of chemical action, experience enabling him to judge accurately, from the appearance presented by a small quantity of the slime which he takes up and washes in a small bowl, whether the torta is deficient in quicksilver; in the former case it is hot, and lime is applied to counteract the excess of the bichloride of copper. When the quicksilver is fully absorbed lime is added, to stop all further action. The period necessary for effecting the amalgamation varies in different parts of the country, and at different seasons. At the gold and silver mines of Ptalpuxahua, where the amalgamation-floors are covered with extensive and well-built galeras or sheds, the process occupies from four to six weeks; elsewhere eleven to fourteen days are thought sufficient.

The amalgam is separated from the mass either by washing in a large square vat, where it is stirred by the feet of men, and subjected to the action of a stream of water—the lighter particles presently flowing off in channels set with small basins, which arrest any stray amalgam the stream may hold suspended, whilst the great body of the amalgam remains at the bottom of the vat; or the ore, after being stirred by long wooden teeth attached to a cross-bar, in a vat supplied by a stream of water, the slime passing off from this vat is similarly acted on in a second vat and in a third.

At Pachuca, Bolanos, Oaxaca, and Real del Monte, the German barrel process of amalgamation has been adopted; but, in judging of results, the Mexican process, though simpler and slower, is to be preferred. In the process termed the Freiberg process, the ore, containing about 25 per cent. of iron pyrites, is roasted in lots of 500 lbs. each, in furnaces made for that special purpose. To ensure the proper percentage of pyrites, where the ore does not contain it, the required amount is added; or if the ore itself contains more, the surplus is picked out by hand, or a portion of the pyrites is reduced by heat before the commencement of roasting. The ore is first dried for twenty minutes, then the fire is made hot, and in two hours the mass becomes red-hot. The fire is then allowed to go down, and the ore is kept at a low heat until the ore is dark in colour, and has ceased to emit any sulphurous smell. The heat is then raised again for three-quarters of an hour. The ore is now taken out and pulverised, and then put through the barrel amalgamation. The barrel, which is 34 in. high and 34 in. in diameter at the head, receives about ⅙ ton of the pulverised ore, 300 lbs. of water, and 100 lbs. of wrought-iron in fragments. The barrel is then made to revolve rapidly for two hours, and the contents are then examined to see if they are of the proper consistence, which should be that of cream; if too thin, an addition is made of powdered ore, and the barrel is again set revolving. When the condition of the paste is satisfactory, 500 lbs. of quicksilver are poured into each cask, which must revolve eight hours. The amalgamation being finished, the barrel is filled with water, and made to revolve slowly, to allow the amalgam to settle at the bottom, and at the end of two hours the mercury is allowed to run into a pan at a little hole in the bottom of the barrel, and the earthy matter is afterwards let through a sluice to catch such amalgam as was not caught in the pan. A number of these barrels ordinarily work side by side. They will amalgate two-thirds of a ton each in twenty-four hours. The amalgamation of each ton costs 3 lbs. of wrought iron and ½ lb. of mercury.

The amalgam is now placed in bags, the upper part of which is leather and the lower canvas, and suspended over vats of masonry. Through the lower and pointed end of the canvas the quicksilver rapidly filters out, the remaining mass, meanwhile, hardening in the bag. When of sufficient consistence, the latter is taken and weighed in lots of 30 lbs., each lot being beaten and moulded into a wedge-like form. These wedges are then arranged on a stool three together, and subsequently transferred to the *baso*, on which they are placed in three circular tiers, being afterwards drawn together by a rope tightened round them. Owing to their form, the pressure leaves a central hole, communicating with that of the *baso*. A large bell-shaped copper cover, termed a *capellina*, is now let down from the roof by pulleys, and closes on this hard amalgam, whilst a luting to exclude the air is made round the edge by an admixture of ashes, saltierra, and lama. A wall of fire-bricks is now loosely built round the copper, and a body of charcoal, occupying three times the space thus enclosed, is piled on the copper and lighted. After 24 hours burning the luting is broken, the capellina hoisted up, and a wedge and sledge-hammer applied to the hard mass, which is broken as nearly as possible into its original wedged form. Under the name of *plata guemada* (burnt silver) it is again weighed, put into leather bags in the quantity of about 70 lbs. each, and conveyed to the casting-house to be made into bars. The quicksilver which during the process of burning had oozed out of the central hole, and trickled into the tank of water, is now collected and weighed. The average loss may be taken at 7 to 8 per cent., though on the best ores it is only 2½ per cent. The copper ore used to mix with the lama, to decompose the ores of silver in the process of amalgamation, is purchased at various prices, the average, perhaps, is 1*l.* to 1*l.* 4*s.* for a cargo of 300 lbs. The ore is first reduced by *granzear* (breaking) between two large stones—a most laborious mode. The *tahona* then grinds this *granzear* to a paste, which is spread out to dry on the ground, after which it is well beaten to free it from lumps, and mixed with some ore of sulphuret of copper mixed with iron obtained from the deposit, chiefly of metallic matters, remaining from the workings of the vat in separating the amalgam.

By a narrow Indian pathway, leading from Perote through dark pine and fir forests, the traveller comes upon the bowery valley of Somalhuacan, noticeable for its copper mines. The establishments are numerous, and, though in a backward state, could be easily and not expensively extended. The copper is picked out of holes and burrows from the face of the dizzy cliffs. The whole of these rocks abound in metals, and the

large openings for the extraction of the copper, with the lesser excavations made by those who have worked for gold, appear from beneath like the eyries of so many sea birds. The copper is like that known in Cornwall as the yellow ore, and is smelted by a rude native process; it contains a considerable alloy of gold. Silver ore has been found.

At the Government Mint, in the city of Mexico, the silver arrives in bars 2 feet in length, and weighing about 1000 ounces. These bars are first refined, and made to the standard quality, and then melted into narrow pieces, from which they are drawn by machinery into long thin strips, of the thickness and breadth of a dollar. By means of a screw-press, these strips are cut into round pieces of the size of the intended coin, and then have their true weight adjusted, any surplus being filed off; they are then milled at the edges, and sent below to be whitened by boiling in alum water. They are now transferred to the stamping-room, and coined by presses, which are capable of turning out 100,000 dollars in ten hours. When the Government mines were in full operation, 403 men were employed here, and 80,000 dollars were daily coined. The sum issued from this building since its establishment would, if stated, appear incredible.

In conclusion, it may be remarked that late experience in Mexican mining tends to show that in the choice of locations for carrying on mining it is not always the best policy to fasten on the old mines; surface veins that have been opened up have proved already in many instances extremely profitable. European companies have found their advantage in relying for general guidance on the knowledge and skill of the natives of the county, and adapting the organisation of the men employed in their mines to the customs and ideas of the people. C.

PROCESSES OF MINING IN SOUTH AMERICA—No. II.

SIR,—Another mode of amalgamation is to leave to the arrastres only the business of crushing, and to place the fine quartz, with mercury and water, in barrels, which are kept turning on a horizontal axis. This secures a pressing as well as grinding action on the quartz during the process of amalgamation; this constant grinding is of service in breaking up by abrasion that insoluble coating on gold which will frequently prevent mercury from attacking it. The amount of labour and time expended in this process is astonishing; but scarcely a particle of gold escapes absorption from the mercury, and it may be made a question whether the defective amalgamation attaching to more modern processes may not result from not giving sufficient time for chemical action, and sufficient appliances to secure that mechanical abrasion which is at the same time so necessary. The introduction of nitric acid, by dissolving some of the sulphurets frees the gold which they contain, tends to give completeness to the separating and amalgamating processes.

Labour would be very difficult to obtain but for a kind of annual conscription of the Indians, who are employed in the hardest of work such as the stamping of the ores, and raising them from the mines. The mines in which these Indians are not employed, but in which Cholo miners are engaged, are worked in superior style. Their wages are from 4s. to 8s. a day, but it is not the wages which induce them to work, but the custom of the mines, which gives them from the noon of each Saturday to the noon of the succeeding Monday to work on their own account. It frequently happens that the miners discover new veins, and sometimes take the ore of their employers, which was left by them at the end of their week's work, and extract the metal after their own fashion, and in the most rude manner. The quantity of gold and silver obtained in this way has never been calculated. At the small town of Mogoz there has been discovered a stratum of magnetic iron ore, full of particles of gold; and as soon as the heavy rains have descended, hundreds flock thither to collect the sparkling gold, which is found clustering on the surface, as though some electric action, causing it to ooze forth, had taken place.

The SILVER MINING of South America claims an equal share of attention with gold mining. It was in the province of Parco, on the most easterly spur of the Peruvian Andes, and by the remotest sources of the far-branching tributaries of the Amazon, that the Incas procured those immense quantities of silver which astonished the European world. These mines are still worked with great profit, and in their vicinity are mines of rock salt, which is employed in the various processes of extracting the metals from their ores. Indeed, both the mountains and plains of the Cordilleras abound in every species of saline. The shafts sunk in the mining districts are of various sizes and depths, sometimes horizontal, pursuing the course of the metallic vein. They are extremely incommodious to the workmen. In some parts there are spacious chambers excavated, where the ore has been taken out, the roofs of which are supported by huge pieces of timber. The ore is obtained without difficulty by the rude pickaxes and other iron and steel instruments of the miners. It is raised to the mouth of the mine, when the shaft is perpendicular, by ropes, which are pulled by the Indians; and when the course of the shaft is oblique, or horizontal, it is carried on the backs of the Indians, in bags of skin. The interior of some of these silver mines is magnificent in the extreme. So vast is the extent of some of these cavities that they might be supposed to have been formed by Nature herself, or to have supplied the argosies of Solomon. The glittering ore in such deposits gleams from the trickling walls, and multiplies by thousands the images of the torches that light it up. Perched on some narrow shelf, or ledge, the Indian worker may be seen carefully prying amidst the complex veins, driving down with his pickaxe the rattling ore. Decayed and ancient galleries, leading off into darkness, present themselves as memorials of past enterprise and efforts, under those terrible mining laws which made the natives underground slaves. The silver may be seen at times like the tendrils of a tree, climbing from one rocky support to another, as though it had undergone a process of growth not dissimilar from that which takes place in the vegetable world. No discovery, however rich, appears to astonish the South American miner. It is a country the cities of which have been built by wealthy miners, and gigantic public works carried out by means of the metallic wealth it has yielded up.

The ores from which the silver is extracted are of various natures, consistencies, and colours: some are white and grey, mixed with reddish spots, called "plata blanca," or white silver. When this ore is broken it exhibits grains of pure silver. Some ores are entirely black, exhibiting no silver to the naked eye. There is a coarse lead, in which silver appears when it is scratched with a hard instrument; this is generally the richest. Specimens of this ore, when broken, frequently exhibit pure silver in lumps. Another species, very hard, when rubbed against any hard substance becomes red. There is one ore that is brilliant, like talc: another green, called "cobrisso," or copperish, which is common: the others are rare.

The cone-shaped mountain of Potosi, that for three centuries has been pouring forth its inconceivable and apparently exhaustless wealth, may be looked to as the great seat of silver mining. Shrubless and bare, the mountain, and its lesser companion, called by the miners "father and son," appear dotted by green, red, yellow, and blue spots. No other mountain in the world has this patched and singular appearance. At different elevations, and on all sides, it has been pierced by tunnels, taking the most varied directions. As night comes on, and the mouths of these tunnels are lighted up—for mining is carried on day and night—a beautiful and striking appearance, such as can be scarcely imagined, is presented. The labourers swarm like ants, and run along the mining galleries on narrow ledges of rock, that skirt dark, sullen cavities of water, covering ancient labours, with an agility perfectly surprising. The richest veins of Potosi are still inundated with water, and the most gigantic undertaking in the country, next to the great wall of the Incas, is the subterranean gallery, 2½ miles long, that was dug under the direction of a German geometrician, sent out by the Spanish Government, with a view to draw off the water from the mines. Another and a later scheme, of forming a gallery that shall intersect the different veins of metal, and the shafts that have been sunk for light and ventilation, has never been carried out. Strange as it may appear, it is nevertheless true that the miners of Potosi carry on their work without any proper tools. Even old and broken scissars, knives, &c., are employed. A system of working a mine which remunerates the labourer according to the quality of the ore he may happen to fall in with, giving him to a certain extent a choise of the course he will pursue, is found, where adopted, to have a stimulating effect; the chance of large gains sharpens the perceptive faculties, and productive veins are not so likely to be slurred over or missed. Where this system has been adopted 200*l.* or 300*l.* has been obtained from a miner in one month.

In silver mining the arastra is not employed, as in gold mining, for purposes of amalgamation, but simply for crushing the ore. It is frequently, nevertheless, used in washing out the paste after amalgamation. A trough, in preference to this large tubs, with revolving shafts, to which streams of water are admitted, are in common use. These mills are usually situated in a large pit or yard, containing various offices for the superintendent and workmen, and stables for the mules. These mills resemble nothing so much as a common French plaster mill: the wheel is about 25 or 30 feet in diameter, and is so constructed as to lift up and down an iron or copper hammer, weighing 200 lb., by which the ores are reduced to a very fine powder. The timbers for the axles of the wheels are of extraordinary strength. Each mill is attended by two or three Indians, who pace onward with muffled faces, in order to prevent the inhalation of mineral dust. Frequently, before the ores are reduced to a fine powder they are placed in ovens, or furnaces, to render them more friable. The powder is sifted through fine iron or copper sieves, which are large, and handled by four or five Indians, the fine powder being then taken away for amalgamation, and the coarse returned to the mill. The ore is sometimes pulverised with water; if dry, it is afterwards wet, and after being well kneaded by the feet of the Indians, the mud is laid upon a floor in square parcels of 1 foot thick, each about 200 lbs. weight. About 200 lbs. of common salt is thrown over these heaps, and incorporated with the metallic mud. If the mixture, on being further tempered with water, is a greyish white, the amalgamation has proceeded favourably; if a dark colour, with occasional brown spots, is presented, there is evidence of a surcharge of copper pyrites, which lime must be employed to neutralise. An addition of copper pyrites is needed where the mercury continues fluid.

Argentiferous copper ores are subjected to the following process:—Should the ore not contain lead, then, after it is pulverised, pulverised lead ore is thoroughly mixed with it, and the whole is subjected to a heat great enough to melt the lead, but not to melt the copper. The melted lead carries off the silver with it. In the furnace no flame is admitted to the ore, for that would oxydise the lead, and prevent it from carrying off the silver. The heat is not raised to such a degree as would melt the silver alone, for when silver is mixed with lead, even in ore, it melts at a much lower figure than when pure. Should there be, as is continually the case in South America, more than 20 ozs. of silver in 100 lbs. of ore, much of the silver will be left behind The proportion of mercury judged proper—the quantity depending on the supposed richness of the ore—is added. From 4 to 6 lbs. of mercury is the general allowance to 1 lb. of silver. The masses are now stirred eight or ten times a day, to promote the chemical action, and to accelerate the amalgamation of the mercury and silver; and for this purpose lime is also frequently stirred with the mass, and sometimes lead or tin ore. In cold weather the process goes on slowly, and the mass has to be stirred during a month or six weeks. The mass thus prepared is then carried to the vats, made of stone or wood, and lined with leather, into which a current of water is directed to wash off the earth. There are commonly three vats through which the mineral is passed, and the same process is performed in each. When the water runs off clear the amalgam is found at the bottom of the vats. This is put into a woollen bag, and hung up for the quicksilver to drain out; it is then beaten with flat pieces of wood, and pressed by a weight laid upon it. When as much of the quicksilver as can be got out by this means is expelled, the paste, or residuum, is put into a mould of wood, made in the form of a pyramid, at the bottom of which is a copper plate full of holes; after it has become hard the mould is taken off, and the mass, with its copper bottom, is placed over a vessel of water, and is covered with an earthen cap, or reversed crucible, on which ignited charcoal is placed, in order to evaporate the quicksilver, some part of which is collected by the cap with which the mass is covered, and is saved. After the evaporation there remains a lump of grains of silver, which require to be fused before they are united into a mass. In several other provinces, instead of triturating wheels, grindstones to pulverise the ore are used.

The most approved form of the salt solution process is the following:—The ore is roasted with 5 per cent. of common salt for several hours. The silver having thus been formed into a chloride, the ore, being at red heat, is thrown into a boiling saturated solution of common salt. The chloride of silver is then dissolved, and whilst at this high heat the solution is filtered, a small quantity of muriatic acid and copper is thrown into the mass, aiding in precipitating the silver. This method of amalgamation differs in the order of the process from those adopted in Mexico, where mercury is added after the salt and calcined copper pyrites have been applied—the salt in the proportion of from 3 to 5 per cent. of the ore, and the calcined copper pyrites, which contain 10 per cent. of sulphate of copper and iron, to the extent of about 28 lbs. for every ton of ore.

It has been ascertained from experience that the richest mines are the deepest, and the deepest mines are, of course, the most exposed to inundations from the water. The richest veins of Potosi have been inundated, and so has the mine of Lipes. When this mine was first discovered the owner cut the silver out with chisels, but the water soon flowed in, and obliged him to abandon it.

The large supplies of coal in the vicinity of the South American mines afford great facilities for roasting ores charged with the sulphurets, so inimical to the action of mercury, and which, accordingly, so seriously interferes with amalgamation. The same result—the letting free of sulphurets of iron, copper, and lead—is also attained by exposing the ore for a lengthened period to the action of the atmosphere. Both processes, however, are expensive, the one in the consumption of labour in getting the coal and preparing the furnaces, and the other in the consumption of time.

QUICKSILVER, so essential to the miner's art, is found distributed over the argentine and auriferous regions of South America. Many of the richest mines, which were closed almost as soon as they were opened and worked by the jealousy of the Viceroys of Spain, who desired to supply quicksilver only from the mines nearest their capital, have since been worked. The dip of the metalliferous veins is variable, but always from the north-west to the south-east. Mercury is commonly found in a sulphuret, or cinnabar, a red, heavy mineral, found not in veins of regular width, but in large irregular masses, connected by small seams. Much porous limestone rock is contained in the veins themselves, and on the rock being violently shaken the liquid quicksilver flies out in minute globules. The uncertainty attending quicksilver mining, the variableness of the deposits, which have literally to be hunted up, and the extensive furnaces and apparatus necessary to drive off, cool, and condense the fumes, render the employment of considerable capital necessary. At one mine several hundred men will be employed. Two-thirds of their time is employed in following up little seams, almost valueless in themselves, to the great masses, which sometimes are from 20 to 50 ft. square. The work is carried usually at high elevations, the tunnels sometimes starting from shafts, but oftener commencing in the sloping sides of the mountains. To obtain the quicksilver, the ore is placed in a walled-up chamber, in front of a wide and deep fire-place, and so disposed that the flames of the fire may pass readily in and between the several pieces. Beyond the ore chamber is a condensing chamber, the floor of which is water, and this is so partioned off that smoke, fumes, and vapour must travel up and down some half-dozen times before any exit is obtained. Long before the chimney has been reached the quicksilver fumes have been condensed. Any remaining sulphur in the quicksilver is absorbed by quick-lime, brought into contact with it in close iron retorts.

In South America, one looks in vain out of Brazil for that extensive and enduring organization of labour proper to mining operations. Even the Spanish and French companies, whilst supplying capital to special mining enterprises, content themselves with supplying their own supervisors, and do not attempt to alter or to reorganise the general system prevailing. Neither is perseverance commonly found amidst South American owners and workers of mines. If a mine does not pay at the outset it is commonly abandoned; a second, third, and fourth owner may carry on operations yet further, whilst successively abandoning the work, they leave to the fifth owner the profits of their toil. Thus the Copiapo Silver Mines are now, after a long period of almost fruitless labour, yielding good returns.

The apparently inexhaustible gold and silver fields of South America are fraught with consequences yet little appreciated by the most far-seeing. The question of productiveness is settled; what is wanted is increased labour and well-applied modern skill for the greater development of this hidden wealth. Although the gold and silver mining regions are, many of them, externally barren, yet it is there that cities have been built, and that agriculture, and all that concerns the well-being of communities, make most progress. Gold, but more especially silver, in South America continues to be looked to not only as a medium of exchange, but as an article of luxury.

The mineros, or mining proprietors, delight in having tables of solid silver, and eating from dishes of gold. Churches and convents are loaded with gifts of the precious metals, and patron saints are personified in the same material. This barbaric taste, however, for conserving the metals for their own intrinsic worth, instead of putting them out to usury, is giving way under the demand for European luxuries and necessities. Nevertheless, long may the silver chafing dish of burning perfumery be presented to the master as a first salutation—the emblem of an hospitality never wanting in those distant regions. On the whole, it may be said that improvements in mining are making headway in Brazil, Chili, and Peru, for even in the latter country the mines are now better worked than formerly. Steam-engines have been introduced at the mills, and chemistry in its relations to the metallurgic art, is beginning to be well understood.

The advices from Buenos Ayres indicate that with the restoration of peace increased activity is being imparted to the mining business in that region. Thus arrangements have been matured for opening the silver mines in the province of San Juan on an extensive scale, with the best European machinery that can be obtained, and the adoption of the most advanced processes. C.

MINING IN CALIFORNIA—ANNUAL REVIEW.

At the present moment, when we are hoping for good results from gold mining adventures so near at home as North Wales, the review of the progress of mining in California must be particularly interesting, both as affording information upon the difficulties which have to be surmounted, even in what may be designated established gold countries, and as enabling an opinion to be formed as to the best mode of working, as proved by experience. The San Francisco *Mercantile Gazette* gives a very interesting review of the progress of mining in California and in Nevada territory, and from which we make the subjoined abstract.

During the past year the operations in gold mining have usually been attended with fair average success. The gradual diminution of the yield of the older fields has been compensated by the new discoveries that have been made in other vicinities, so that the total gold product of the year has probably fallen but little, if at all, behind that of the past four or five seasons. The tabular statement, in another place, contains a full exhibit of the product of the past year as compared with the two previous.

With regard to placer mining, it appears that from the northern portions of the state very favourable reports were received during the spring and early portion of the summer, the large quantities of snow upon the mountains, by its gradual melting, extending the season during which the dry diggings and smaller streams could be worked to advantage. A large number of miners visited the mines upon the Colorado river during the past season, but while a few of them were very successful, the majority were compelled to return empty-handed, the intense heat preventing work during the greater part of the day, and the scarcity of water rendering anything but dry washing or mining on the smallest scale impossible, and the regions away from the pools and small gulches almost uninhabitable. Water transported by donkeys was readily sold to the miners at $1 per gallon, and the supply necessarily very limited: 1500 miners were said to be working there in June. The only improvement noted during the past year in this class of mining was a greater saving of the gold in the shape of amalgam taken from the riffles and amalgamated coppers of sluices by means of nitric acid. It has been found that what was formerly regarded as refuse and thrown away, if slowly evaporated, frequently still yields a considerable quantity of gold. The Columbia Fuming Company thus save sufficient to pay the salary of their superintendent. In Hunter's claim, in the same vicinity, after $2500 had been extracted in the usual manner, $385 additional were saved. In other claims from $300 to $1000 per annum is thus gained.

From this it will be seen that with increasing experience the return of gold can be kept up, even with a decreased produce; and with regard to California, it seems that the search for gold leads to the discovery of other minerals, in quantities that well repay for working, and which but for the gold might not, for many years to come at least, have been discovered.

The copper mines of Calavaras county continue to be worked with undiminished success and profit. The main ledges are being thoroughly opened, and the shipment of ores is increasing. Agents in this market now purchase all suitable ores offered, for shipment to Boston and Swansea. The value is ascertained by assays of selected samples. Such ores in Boston are said to be worth $6 per ton for every 1 per cent. of metal they contain; thus 10 per cent. ore would be worth $60. The rate of advance made to shippers is 50 per cent. on shipments to Boston, and 60 per cent. on shipments to Swansea. The freight is $9 per ton to Boston, and $11 per ton to Swansea. Expenses are estimated as follows:—Ore mined and at pit's mouth, $2·50 per ton; freight in teams to Stockton, $5·50; by steamer to San Francisco, $1·50; sacks, commissions, assays, and sundry expenses of shipment, &c., $8; add freight, gives cost in Boston, $26·50, and in Swansea $28·50. A very fair profit may thus be made on the shipment of ore of 20 per cent. and upwards. By selecting and assorting the ore at the mine, and reserving the poorer qualities until the expenses of freight, &c., are reduced, or their working here is possible, the business, though hampered, will be remunerative. North of Calaveras, in Amador and Plumas counties, other discoveries of the same kind have been made, and are receiving due attention at the hands of the miners. In Amador copper leads were discovered near Lancha Plana, and since then prospecting for such claims has been very active. The Newton lode is believed to be very valuable. Fifteen or twenty companies are prospecting between the Mokelumne river and Horse creek, and the opinion exists that the belt of country in which such leads will be found is at least three miles in width. In Plumas county the leads discovered in Green Valley in 1861 are proving to be valuable. Several tons of the rock is stated to have been shipped to Boston, to be thoroughly tested, In the Mountain Meadows district a number of leads captaining copper, with a small percentage of gold and silver, have been found. The rock is said to be plentiful, and readily obtained. In Santa Clara county, on Penetencia Creek, a rich vein, containing much virgin copper, has also been found. The success attendant upon silver mining in Washoe, and the value of the ledges there, and the knowledge of that kind of mineral acquired by our miners, has stimulated a search for the same kind of leads in this state, and the work has not been barren of results. In Plumas county a number of such ledges have been found, 12 miles from Quincy, at Spring Garden Ranch, Round Valley, and other places. The Sprout ledge is most noted as yielding rich silver rock, and considerable native metal, and has been traced for several miles. Other ledges are also mentioned, shares in which sell as high as $75 per foot. This class of mining, though yet in its infancy, promises to become important. Many of the quartz leads, now worked solely with a view of saving the gold, are known to contain percentages of silver, that elsewhere would be saved with great care. As more experience is obtained in Washoe its results will be availed of here, and a considerable increase of profits will in many instances be secured. No new discoveries of cinnabar have been reported, but little has been done as yet towards developing the leads found in Napa county a year or so ago. Two of the companies are erecting retorts, and have reduced small quantities of quicksilver. The damage done to the roads by the floods of last winter necessitated very expensive repairs, and prevented access with machinery and heavily loaded beams until late in the season.

Discoveries of coal beds have been reported in a number of new localities during the past year, and some of the samples exhibited and tested were of a quality sufficiently good to make them useful for many purposes. In the Coast Range, between the Bay of San Francisco and the San Joaquin river, some of the mines first opened are being rapidly developed, and considerable quantities of their coals are sent to this market, and used on steam-boats and otherwise. Two railroads are projected, and the necessary surveys and locations made to carry the coal to the water. In Sonoma country three veins are opened; one eight miles from Petaluma, in the Santa Rosa mountains, another near Santa Rosa, and the other on a branch of Mark West creek. At the latter place the bed has been shown to be two miles long, the width varying, and the coal is said to be of good quality. Four shafts have been sunk, and two tunnels, 170 and 190 feet long, run in opening the mines. In Mendocino county, in June last, a vein of coal, said to be extensive, was found by workmen on the site of a wharf they were building at the embarcadero. In Tehama county, ten miles from Millville, on the Honey Lake road, a vein 5 or 6 ft. in thickness, and said to be of good quality, was found. In Sacramento county, on Dry Creek, seven miles from Folsom, a bed of superior coal was found, which was tested by the Folsom Gasworks, and pronounced well adapted to the manufacture of gas for street lighting. Preparations are being made to work the mine extensively. In Butte county, near Oroville, the Table Mountain Coal Mining Company have commenced operations on a large scale, and their coal is to be used by the Oroville Gas Gasworks. On the Santa Anna river, 35 miles from Los Angeles, coal has also been found. Mineral oil springs have also been found in several localities. One in Santa Barbara county is said to be capable of yielding upwards of 3000 gallons per day, of which 60 per cent. is coal oil, yielding, at a low temperature, large quantities of inflammable gas, well adapted to illuminating purposes. In Contra Costa county, near San Pablo, an extensive establishment has been built for the purpose of manufacturing oil by pressing the earth which is saturated with it. The company expect, by boring, to find the vein from which the supply is derived, and probably bituminous coal. Oil springs have also been found in several localities in Santa Clara county.

In connection with the Nevada territory, there is nothing particularly interesting to the English reader, except the reference to the processes in use. No great stir has been made concerning new processes for the extraction of silver and gold from the rock, though doubtless the business is becoming better understood, and more experience and scientific knowledge is applied to it. The successful mills use salt, sulphate of copper, sulphate of iron, catechu, alum, salamomac, salt cake, &c., but a large loss still occurs in the slum or thin mud drained off from the vats, and it is said that often only 40 per cent. of the precious metal is saved by the processes now used, while scarcely any attempt is made to preserve the tailings, &c., for future working. Yet as showing the improvement made in Washoe in the working of such ores over the old processes now used in California, Mr. A. B. Paul states that at the Oriental Mill at Grass Valley, California, 18 tons of rock were worked by the old process, and yielded 62 ozs. of gold. Afterwards the tailings were worked over by the Washoe process, and yielded 34 ozs. additional. Such results are owing more to additional and improved mechanical appliances than to new chemical discoveries, and the thorough working of the material is nearly the whole secret. It is also found that with the depth to which the leads are opened the percentage of silver contained in the rock increases, and Mr. Paul states that Gold Hill leads, which at first yielded ·462 gold and ·450 silver, now yield ·433 gold and ·931 silver, having been opened to a depth of 150 feet. These figures indicate the more perfect saving of the silver rather than a falling off in the gold. The California quartz leads also contain more silver than is usually supposed, and this also increases with the depth from which the rock is extracted. Thus rock from the same leads at Grass Valley, that formerly yielded ·970 gold, recently worked with improved machinery (steam pans, &c.), as used in Washoe, yielded ·480 gold, ·360 silver, and ·160 base metal. The leads in the Humboldt River districts, that have yielded ·90 of gold to ·10 of silver, it is said will soon yield ·25 or ·30 of silver in the 100 parts.

QUICKSILVER.—Statement of receipts and exports and sales of quicksilver from New Almaden, for the year 1862:—

MONTHLY RECEIPTS.

March	Flasks 1,744	Aug.	Flasks 3,928		
April	8,718	Sept.	3,973		
May	3,254	Oct.	3,415		
June	4,040	Nov.	3,074		
July	4,335	Dec.	3,190		
Total			39,671	....	2,957,325 lbs.
Balance on hand Jan. 1, 1862			5,861	....	439,575 lbs.
Total			45,532	....	3,414,900 lbs.

EXPORTS FOR THE YEAR.

To Mexico	Flasks 14,332	..	Lbs. 1,067,400		
To China	5,435	.....	407,625		
To South America	5,185	.....	388,875		
To England	2,000	.....	150,000		
To New York	1,000	.....	75,000		
To Australia	800	.....	60,000		
Sold in San Francisco	11,693	.....	876,975	—40,345	3,025,875 lbs.
Balance on hand Dec. 1, 1862			Flasks 5,187	....	389,025 lbs.

The product of the Enriquita Mine during the year has been 519 flasks, and the balance on hand is 21 flasks.

The New Idria Mine produced nothing in 1862. On hand at this time, 77 flasks.

The agent of the Guadalupe Mine declines to give statistics. This mine in 1861 produced 2550 flasks, or about 10 per cent. more than the Enriquita (located in its immediate neighbourhood) during the same year.

From the above figures it would appear that the product of this mineral has diminished; but the falling off is with the more recently formed companies. New Almaden has increased nearly 25 per cent. as compared with 1861. Our statistics of exports also indicate a falling off, and are as follows:—

New York	Flasks 2,265	Central America	Flasks 40
Great Britain	1,500	Japan	25
Mexico	14,778	Australia	800
China	8,725	Victoria	5
Peru	3,439	Panama	424
Chile	1,746		
Total flasks			33,747

The exports for the preceding four years were as follows:—

1858	Flasks 24,132	1860	Flasks 9,348
1859	3,399	1861	35,995

COAL AND IRON IN FRANCE.

The official documents which have been recently laid before the French Chambers contain the following returns with regard to the production of coal and iron in France, and the importation of British iron, which will be interesting to many of our readers:—

COAL.—The production of coal in France was, in 1859, 7,500,000 tons; 1860, 8,039168 tons; 1861, 8,400,000 tons; 1862. 9,400,000 tons. The price of coal at the pit's mouth was, in 1860, 9s. 1¼d. per ton; 1861, 9s. 1¾d. per ton; 1862, 9s. 0¼d. per ton. Notwithstanding the rapid increase in the production of coal in France, it will be observed that it amounts to one-tenth only of the quantity yielded by Great Britain.

IRON.—The production of pig and cast iron in France was, in 1862:—Smelted with charcoal, 285,000 tons; value 1,949,200*l.*; per ton 6*l.* 16s. 6d. With coke, or coke and charcoal mixed, 768,000 tons; value, 3,456,000*l.*; per ton, 4*l.* 10s. Total of all qualities in 1862, 1,053,000 tons; value, 5,405,200*l.* The production of pig and cast iron was, in 1861:—Smelted with charcoal, 298,000 tons; with coke, or coke and charcoal mixed, 590,000 tons. Total of all qualities in 1861, 880,000 tons. The total production of all descriptions of pig and cast iron was, in 1859, 856,152 tons; and the total in 1862 having been 1,053,000 tons, it appears that there has been an increase in the total production in France during three years of nearly 25 per cent. The quantity of bar and other descriptions of wrought iron manufactured in France was, in 1862, with charcoal, 71,100 tons; value, 1,194,800*l.*; per ton, 16*l.* 16s. 1d. With charcoal and coke mixed, 29,400 tons; value, 404,000*l.*; per ton, 13*l.* 14s. 10d. With coal, 600,000 tons; value, 5,724,000*l.*; per ton, 9*l.* 10s. 9d. The total of all descriptions of bar and wrought iron manufactured was, therefore, in 1862, 700,500 tons; value, 7,322,800*l.*

The quantities manufactured were, in 1861, with charcoal, 76,600 tons; with charcoal and coke, 32,400 tons; with coal, 493.700 tons. The total quantity manufactured in 1861 was, therefore, 602,700 tons. The quantities manufactured were, in 1859, with charcoal, 90,660 tons; with charcoal and coke, 16.930 tons; with coal, 412,510 tons. The total quantity manufactured in 1859 was, therefore, 520,000 tons; and the total manufactured in 1862 having been 700,500 tons, it appears that there has been an increase in the total production in France during three years of 180,500 tons, or more than 33 per cent. The quantities of British iron imported into France during the first 11 months of 1862 were—Pig-iron, 149,551 tons; bar-iron and rails, 41,565; plates, sheets, and tin-plates, 2650; all other descriptions, 7023 tons.

It is impossible to examine the foregoing returns without being struck not only by the rapid increase in the production and consumption of iron in France, but also by the extreme smallness of the importations from Great Britain, the largest and cheapest producer of iron in the world. The annual production of pig-iron in Great Britain now amounts to 4,000,000 tons, of which 2,500,000 tons are manufactured into bars, rails, plates, sheets, and other descriptions of wrought iron. The prices of iron are comparatively high in France. The returns from which the foregoing particulars have been abstracted state them to have been higher for similar descriptions in 1862 than in 1861. In Great Britain the very low prices of the last five years fell still lower in 1862. The importations of British iron into France scarcely amount to 5 per cent. of the total production of Great Britain. It is evident, therefore, that with regard to one, at least, of the most important branches of British industry, the recent Treaty of Commerce is not based on sufficiently equitable principles. J. K. B.

MINERAL OIL AS FUEL.—Mr. E. J. Biddle, of New York, has provisionally specified an invention for the use of petroleum or coal oil as fuel, and for the machinery and apparatus employed. He proposes more particularly to apply it for generating steam for operating machinery. The furnace, which may be of any suitable size or shape, is constructed of ordinary materials. Instead of the grate or bars now used the bed of the furnace is constructed solid to prevent the escape of the fluid. This bed may be made either smooth or corrugated. The draught is obtained through a grating in the side or end of the furnace, which admits the air, but confines the flames, and an additional supply of air comes to the flames through pipes terminating within the walls of the furnace. The oil enters the furnace at the bottom, and is at first ignited by surrounding the mouth of the pipe through which it passes with a small quantity of burning coals. A cap may be placed over the furnace for protection in case the flame should escape through the grating. Tanks for holding the oil are provided with pipes, which permit the escape of the explosive gases, and render the use of this oil perfectly safe. These tanks are connected with each other, and with a distri-

buting reservoir by pipes of a suitable size. A steam or hand-pump may be employed to draw the oil from the tanks to a distributing reservoir. From this the oil passes into the furnace, the flow being regulated by a stop-cock. A waste pipe carries back any surplus from the reservoir to the tanks. The fuel is described as cheap and convenient. When used on steam ships it economises space, no fireman or stokers are needed, and steam can be very speedily raised on lighting the fire.

LITERARY NOTICES.

Heat Considered as a Mode of Motion. By JOHN TYNDALL, F.R.S., &c., Professor of Natural Philosophy in the Royal Institution. London: Longman.

The consideration of the nature of the properties of Heat is, without doubt, one of the most interesting studies that can be entered upon, and in the hands of the lecturer there is, probably, no subject in which there is more ample scope for the display of a knowledge of facts, and an ability to impart knowledge without tiring an audience, or rendering a discourse too technical. During last season Prof. Tyndall, F.R.S., delivered an extremely interesting course of twelve lectures on "Heat Considered as a Mode of Motion," at the Royal Institution of Great Britain; and he has given the general public an opportunity of profiting from his researches by the publication of the lectures in an amply illustrated volume. He tells us that he has endeavoured to bring the rudiments of a new philosophy within the reach of a person of ordinary intelligence and culture, and we have no hesitation in stating that the work is one which cannot be read through without the opinion being formed that he has most perfectly accomplished his object. The first portion of the course deals with thermometric heat—its generation and consumption in mechanical processes, the determination of the mechanical equivalent of heat, the conception of heat as molecular motion, the application of this conception to the solid, liquid, and gaseous forms of matter, to expansion and combustion, to specific and latent heat, and to calorific conduction; whilst the remaining portion is occupied with the consideration of radiant heat—the interstellar medium, and the propagation of motion through that medium, the relations of radiant heat to ordinary matter in its several states of aggregation, terrestrial, lunar, and solar radiation, the constitution of the sun, the possible sources of his energy, and the relation of that energy to terrestrial forces and to animal and vegetable life.

The whole of the most important principles to be inculcated are familiarised to the reader by the extremely simple and homely experiments by which they are demonstrated; whilst many of these experiments are so beautiful and conclusive, that the description of a single one of them is worth far more than the cost of the entire book. Not that we would state that the experiments are all new to the scientific world, though to the majority of those who will read Prof. Tyndall's book they certainly will be so; but they are not of that class of experiments usually given in popular philosophical works, and many of them are capable of application at home in the construction of exceedingly interesting philosophical toys. Prof. Tyndall makes ample acknowledgment to those whose labours in the same direction as his own he has availed himself of, yet a freshness and vigour prevails the whole course of lectures which would no doubt have enabled him to appropriate much with impunity. The entire course of lectures being based upon experiments, it will be obvious that even to allude to the more striking ones would necessitate the occupation of more space than we have at our disposal; and although the very beautiful artificial geyser, which explodes and throws up its boiling fountain regularly every five minutes, will probably be the first to attract the general reader's attention, we may assure him that this is by no means the most interesting which the book contains. The work, as a whole, is one which is calculated to diffuse much sound science amongst the people, and one which cannot fail to teach all who read it to think with method and advantage.

The Cassiterides (or Tin Islands); an Enquiry into the Commercial Operations of the Phœnicians in Western Europe, with particular reference to the British Tin Trade. By GEORGE SMITH, LL.D., F.A.S., &c. London: Longman, Green, Longman, and Roberts. 1863.

The reason that called forth this work from Dr. Smith is clearly stated by him at page 1. "For many ages it was currently believed that the Cassiterides were either a part of Britain, or islands contiguous to its coast; and that the tin supplied to the East was brought direct from them by Phœnician merchants. This opinion is still received as an established fact by great numbers of well-informed persons in this country and abroad. But recently great doubt has been raised on these allegations; and a growing scepticism avowed by several intelligent writers: among others, Mr. W. D. Cooley, in his 'History of Maritime and Inland Discovery,' and Sir G. Cornewall Lewis, in the 'Historical Survey of the Astronomy of the Ancients,' have spoken strongly against the probability of a very early direct intercourse between the Phœnicians and Britain." We need not stop here to inform our readers that tin was known in the days of Moses, and found among the spoils of the Midianites (Numbers, xxxii. 22); and that it was also mentioned by the most ancient authors as a metal well known, and one that was supplied by the great marts of that day—Tyre and Egypt; but it was intimated by those authors that these celebrated markets imported that metal. And the question that has been often asked, and been many times answered by Dr. Smith and others, is again put before us. Page 3—"Was tin in the earlier ages brought to Sidon and Tyre from the east or the west? from India, or from Spain and Britain? This question, we confess, has long since been settled in our minds; but as Mr. Cooley, in preparing himself for writing his late work, appears to have looked either into Arrian's work, the "Periplus," or into his translator and commentator, Dr. Vincent, and found among the trade lists of Egyptian merchants, about B.C. 100, the article "Tin," and without taking the trouble to ascertain whether this metal was imported into Egypt from India, or exported, assumed the former, and then dreamed that the Banca tin streams were fully as work then as we find them now, and came to the conclusion we find in his work, that "Tin has been in all ages a principal export of India," and that the Egyptians imported tin from the East Indies. A more unfounded statement could not be made by any respectable scholar. But let us examine it by an extract from Dr. Smith. At pages 7 to 14 we have a most interesting and extensive list of the exports and imports of those seaports and districts (that traded with Egypt) on the east coast of Africa, from near the head of the Red Sea to about ten degrees of south latitude. Among the exports from Adooli and Abalites within the Straits of Bab-el-Mandeb, Malaõ, Mosulion, Opone, and Rhapta, &c., without the Straits, we find the following articles:—Ivory, horns of the rhinoceros, gums, tortoise-shell, myrrh, frankincense, cinnamon, tila, slaves, fragrant gums, incense. Among the imports from Egypt we find the following articles:—Cloth of Egyptian manufacture, robes of Arsinoè or Suez, dyed cloths, linen, striped or fringed cloth, glass or crystal, porcelain, white copper for ornaments and for coin, gold, brass, iron, hatchets, adzes, knives, brass drinking vessels, denarii or specie for the use of merchants, wine, oil, gold plate, silver plate, watch coats, camp cloaks, coverlids, Indian cottons, cotton for stuffing couches, &c., sashes, muslins, gum lac, flint glass, *tin*. Thus far we find that tin was exported from Egypt to Eastern Africa; let us now examine the exports and imports of those seaports on the Asiatic side of the Red Sea, and the coast east towards Ceylon. At pages 14 to 22 we find among the exports of Mocsa, just within the Straits of Bab-el-Mandeb:—"Myrrh, stacte or gum, white stones, alabaster, &c. At Kane, east of the Straits, on the coast of Arabia, the exports were frankincense and aloes. Near the Persian Gulf the exports were pearl in great quantities, but of an inferior sort, purple, cloth, wine, dates, gold, and slaves. From the mouth of the Indus, spice, called costus, bdellium (a gum), yellow dye, spikenard, emeralds, sapphires, furs from China, cottons, silk threads, indigo. From the Gulf of Cambay, the exports were—Onyx stones, porcelain, fine muslins, cottons, &c., ivory, box-thorn, silk, long pepper. From other ports towards Goa we find the exports are—Pepper, pearls of a superior quality, ivory, fine silks, betel, all sorts of precious stones, diamonds, jacinths, rubies, tortoiseshells from groups of isles near Banca; but not a word about tin. Let us now examine the imports of these marts we have named. Purple cloth, clothes, muslins, cloaks, quilts, sashes, perfumes, saffron, specie, plate (wrought), horses, carved images, sandal-wood, wood squared, horn, ebony, brass, coral, storax, tin, wines, lead, topazes, sweet lotus, white glass, ore of cinnabar, stibium, orpiment. Here, if we take Arrian for our guide, nothing can be more satisfactory than this, that in his day tin was exported to India through Egyptian merchants, and not imported, as Mr. Cooley and others would have us believe. Having failed to find the source from which tin was supplied in the East, let us follow Dr. Smith to the West. After showing that the Phœnicians established colonies at Cyprus, Rhodes, and Crete, and at Sicily also they had several establishments, but about 740 B.C. they took up a position on the north-west angle of Sardinia, and remained in possession of that post for a considerable period. The Phœnicians also took possession of Malta, and found it "at first a bare rock of limestone, brought soil from the neighbouring coast of Africa, and provided it with the means of cultivation, until its fertility became proverbial." Traces of this most enterprising people are to be found also in the history of Sardinia, Corsica, and other islands. After establishing themselves in the most convenient points in the Mediterrancan, they passed through the Straits of Hercules (or Gibraltar), explored the shores of the Atlantic, and formed settlements on the coasts of Africa and Spain. The most celebrated as well as the most important on the shores of this ocean was "Gades," or "Gadeira" (Cadiz), on the coast of Spain. This event took place at least 1100 B.C., but the Phœnicians had been tin merchants long before the fall of Troy, about 1200 B.C. They had supplied the western shores of Asia with tin as early at least as the days of Joshua, 1600 B.C., for "tin was used in articles of the most elaborate design and manufacture before the Trojan war;" and as there was no supply of this metal, as far as we can learn, from the East, there must have been a known market from whence it was procured. All our sources of information agree, therefore, in placing the Phœnician tin market at Gades for several centuries before 1100 B.C. Whence was this market supplied? We are told by some "that tin in ancient times was abundant in Spain."—Page 45. There may have been tin raised in the granite districts of Spain, but that the supply from this source should have been sufficient for the whole Phœnician trade for 1200 years, and that the ancient authors should have been ignorant of the fact, or have called Spain only Cassiterides, is too absurd to be credited by any person who has made himself acquainted with the subject, or by anyone who will spend a few hours to consult the authors who have written on the ancient tin of the Phœnicians. There remains but one other source from which the ancient tin market could be supplied—Cornwall and Devon, and for some time, perhaps, the Scilly Isles. The extent to which the tin streams and the backs of lodes have been worked in Cornwall show that ancient mining must have been carried on very extensively, and for a very long period, for there is scarcely a valley or flat piece of ground in the county that has not been streamed for tin, and many of them several times over; and it is a thing of rare occurrence to find a lode whose back has not been worked by the old tinners many centuries before. And we venture to say that if our readers will follow Dr. Smith through the remaining 100 pages of his work, they will be fully satisfied that Britain was the great source whence the Phœnicians had their tin. We are aware that difficulties have been urged by respectable writers to the views we take: one is the length of the voyage from the Straits of Gibraltar to Mount's Bay. Now, we confess that we see no difficulty to believe that men who could navigate from Tyre to the Canary Isles could also navigate from Cadiz to Cornwall. We are also told that tin was carried overland to Marseilles; this is, no doubt, true, but the tin trade with the Phœnicians had been carried on for at least 1000 years before this period. The undefined manner in which the Greek and Roman writers apply the term Cassiterides is also urged as a great difficulty to our view. We scarcely need inform those gentlemen that if these writers had been Phœnician historians, they would, no doubt, have furnished us with more certain information; but we need not be surprised at the vague, and often contradictory manner in which these ancient authors speak of an island or islands so little known, only by very few, except the Phœnicians themselves, and with scarcely any means of obtaining information, except by the tedious and expensive method of a voyage to Britain, if a passage could be procured, when we have evidence in our day, with our railways open, that men not 500 miles from our mines have sent forth to the world statements just as absurd and ignorant, so far as Cornwall and its miners are concerned, as those old writers have ever stated about Cassiterides. And the men who can, with two or three late writers on the subject, believe that the ancient tin market was supplied from any other principal source than Britain, might believe anything, however absurd. In conclusion, we may remark that Dr. Smith has given the subject a patient and vigorous research, and has displayed those qualities of minute investigation which he is well known to possess; and we advise any party who wishes to obtain a complete knowledge of the ancient tin trade to place Dr. Smith's work on his table; the book will form also a valuable addition to the Cornish miner's library: it is a complete handbook on the subject.

PUBLIC COMPANIES' LAW.—A very useful little work upon this subject has just been published, through Messrs. Kent and Co., by Geo. Coulson James. The new law is treated in a very able and popular manner. Mr. James very properly advocates the limited liability principle, and observes that in practice it has been found, as was anticipated by Mr. J. S. Mill, that creditors are well able to take care of their own interest. If any have suffered loss by trusting unsubstantial companies the result is owing to an imprudent credit granted by themselves. It appears that of the 2154 companies registered under the Act of 1856 there are 1620 still in existence; while it cannot be assumed that all returned as subsisting companies are in profitable working, the return is satisfactory as showing beneficial results, the proportion, and what is better still the extent, of failures being remarkably small. As a contrast to the advantages of limited liability, Mr. James gives us a list of only seven companies with unlimited liability, where the shareholders' losses amounted to 2,208,116*l.*—the Mexican and South American Mining Company, where the shareholders paid 86,461*l.* in winding-up, and the Royal British Bank 165,378*l.*, being the lowest on the list. The mode by which an insight into the Act is given is by drawing illustrations from some of the more prominent cases. The work is well worthy of perusal by all interested, either as shareholders or officers, in companies under the Act of which it treats.

POCKET-BOOK OF ENGINEERING FORMULÆ.—A very valuable little book, intended to supersede Adcock's, Weale's, and Templeton's pocket-books, has just been issued (through Messrs. Spon, of Bucklersbury) by Mr. G. L. Molesworth, M. Inst. C.E., and principal resident engineer of the Ceylon Railway. The selection which Mr. Molesworth has made is certainly admirable, and we believe there is no formula to which the practical engineer would be likely to refer but what will be found in the book, although its size is so small that it could easily find a place in the vest pocket. The "Pocket-Book of Useful Formulæ and Memoranda for Civil and Mechanical Engineers" is the result of Mr. Molesworth's experience, and complicated and difficult formulæ have, as far as possible, been avoided, whilst in such cases as render it absolutely necessary to retain a complicated formula, an easy approximate rule has in almost every case been added. To facilitate the calculation of hydraulic formulæ, the crushing strains on columns and other formulæ, Mr. Molesworth has calculated the 5th, 4th, 3·6th, and 1·7th powers for those numbers which are most likely to be required. But perhaps the most important additions are the short tables of logarithms, logarithmic sines, &c., square and cube roots, areas and circumferences of circles, &c., which are quite sufficient for all ordinary calculations. The book is beautifully printed, and, although from the nature of the book it will be obvious that we cannot possibly vouch for its accuracy, we may mention that we have made some hundred calculations with the formulæ and figures given, and we have been unable to discover an error.

NEW DICTIONARY OF CHEMISTRY.—The first part of a new edition of the well-known and highly-esteemed Dictionary of Chemistry of Dr. Ure, so materially enlarged and improved as to be in fact a new work, has just been issued by Messrs. Longman. The editorship has been undertaken by Mr. Henry Watts, assisted by some of the best chemical authorities of which the country can boast—Dr. Hofmann, Dr. Frankland, Dr. Guthrie, Dr. Williamson, Dr. Odling, Dr. Atkinson, and Dr. Russell, being among the number. The work is to be completed in 16 parts, at 5s. each, the first of which has just been issued, and extends to "Ammoniacal Liquors." The system of notation adopted is the unitary hydrogen scale (H_2O=water, &c.); but that no difficulty may arise to those accustomed to the ordinary scale (HO=water), the formulæ of the more common substances are also given according to the dualistic scale, such latter formulæ being printed in italics, to prevent confusion. The articles on "Acetic Acid," "Acetone," and "Acetyl," by the editor, are admirably arranged; and Mr. G. C. Foster is certainly entitled to equal praise for his very excellent article on "Acids." Again, "Alcohol" and "Alcoholometry" are articles of great merit; and Mr. Foster's "Alkali," "Alkalimetry," and "Alkaloids," reflect considerable credit upon their author. With regard to the article on "Aluminium," by the editor, we have an opportunity of judging of the relative merits of the unitary and dualistic systems of notation, and are bound to admit that we consider the latter to be preferable, as the component parts of the substance are more easily shown, and the memory is assisted instead of confused by the formulæ. Take, for example, the hydrates of alumina, which consist of one part of the sesquioxide of aluminium with one, two, or three parts of water respectively. Now, Mr. Watt's tells us that the oxide of aluminium is a sesquioxide, yet writes it, as it of course must be written by the scale he has adopted, Al_2O_3, which certainly has the appearance to the eye of a suboxide, rather than a sesquioxide; and in the hydrates the confusion necessarily increases. According to the ordinary notation, Al_2O_3 is sesquioxide of aluminium, and HO water, and hence we have for the monohydrate $Al_2O_3.HO$; for the dihydrate, or bihydrate as we should call it, $Al_2O_3.2HO$; and for the trihydrate, $Al_2O_3.3HO$. Now, upon the unitary system, the alumina is made Al_2O_3, and the water H_2O; and the hydrates of alumina, Al_2HO_3; $Al_2H_2O_3$; and $Al_2H_3O_3$ respectively, which, it will be seen, do not aid the memory, or show the compound in the slightest degree. We do not make these remarks at all in disparagement of the dictionary before us, but simply to show that the old notation has advantages which we cannot discover in the new, and that the work would certainly not have been deteriorated, whilst it might have been improved, by the adoption of the dualistic system solely, or of both systems, throughout the entire work. Judging from the part before us, the Dictionary of Chemistry will be one of the best in existence, whilst its price will place it within the reach of all who are likely to require to consult it.

MACHINERY FOR VENTILATING MINES.—An improved machine for ventilating collieries has just been patented by Messrs. Ridley, of Morlin, near Leeds, and Jones, of Battersea. At the top of the upcast shaft a hollow rotatory apparatus is placed, which has an opening through its under surface, or through that surface which is next the mine, such opening being by preference of a diameter about equal to the diameter of the upper end of the shaft. This apparatus consists of the under cover or end with the opening into it, and an upper cover or closed end, to which an axis or shaft is fixed in its centre, which passes through the closed end. The interior of the chamber consists of spiral chambers terminating in the periphery. The apparatus is caused to rotate with considerable velocity, in such a direction that the air is drawn from the shaft into the interior, and expelled by centrifugal force from the periphery.

ROPE WHEELS, CAGES, AND TANK FOR MINES.—An invention, the object of which is to afford the means of a ready adjustment of the length of the winding rope or chain between the rope wheel and the cage or article to which it is attached, has been provisionally specified by Messrs. Johnson and Taylor, of Coed Talon. On the shaft of the rope wheel they fix a boss in two parts, each having a flange on the outside, so as to form between them a circular groove, into which is fitted the rope wheel in such manner that it may be turned upon the boss or upon the shaft when required, and afterwards bolted to the side flanges by bolts. In the side flanges they drill, in a circle of a given diameter, a number of holes, and in the solid part of the rope wheel, around the boss, they drill, in a circle of the same diameter, one, two, three, or more holes more than there are in the side flanges, so that the bolts employed for holding the wheel and boss together can be passed into different holes, and thereby obtain a very delicate adjustment of the length of the rope. Thus, when there is one hole more in the rope wheel than in the flanges, if two bolts have been passed through two sets of holes opposite each other, and then withdrawn, so that the rope wheel can be turned to allow them to be passed through the next set of holes, the winding rope will be shortened a distance proportionate to a fractional part only of the circumferential distance between the holes, and if the rope wheel be turned to the next following set of holes another fractional part will be added, and so on, the different numbers of the holes producing an effect similar to the use of the vernier in philosophical instruments. When the boss consists of one part only the rope wheel is to be formed of two parts, in order to place it between the flanges, or the plan may be varied by having the wheel of one piece, and one of the flanges moveable. In another arrangement, for the purpose of shifting the rope wheel to fractional distances, they employ a ratchet wheel and catches, or have ratchet teeth and catches either on the boss or the wheel. They also use, in connection with the above-described pulley, tanks for winding water from mines or collieries. The said tanks may be round, square, or any other shape, and will be fitted with air-pipes passing them through to prevent a vacuum being formed beneath the tank when leaving the water; also an arrangement of india-rubber, or other springs, and wrought-iron straps to connect the tank or winding cage to the winding rope or chain, instead of the usual chains and shackles.

TUBE-PROTECTOR FOR MULTITUBULAR BOILERS.—During the past two years Mr. Arthur Wall has been slowly introducing to the notice of railway companies an improved protector, which, we understand, has given complete satisfaction in every instance where it has been applied. The protector consists of a slightly tapering wrought-iron tube or ring 6 or 7 in. in length, the smaller end of which is introduced into the ordinary tube at the fire-box end. It is found in practice that by this means a great economy is effected, the wearing of the tube-ring being materially diminished without the temperature of the tube being in any degree lowered. Indeed the wrought-iron ring itself acquires the necessary heat for maintaining the temperature, whilst the hot cinders, &c., cannot possibly beat against the copper tubes. When the protector is applied much less cleaning is required, and there is less difficulty in maintaining a regular supply of steam. Mr. Wall has received a flattering testimonial from the Manchester, Sheffield, and Lincolnshire Railway Company, whose engineer, Mr. Charles Sacre, states—"I have had your tube-protectors in use some time, and certainly consider them an advantage, especially in the use of burning coal. There is an action going on just within the ferrule which destroys the tube with a comparative small mileage. The ferrule seems a complete preventive, and certainly must in time become a serious saving of expenditure from the above cause."

TREATMENT OF ALUMINA.—In order to obtain a preparation of alumina, which for many purposes may be used as a substitute for alum, Mr. Alfred Noble, of Bristol, proposes to take clay, or materials containing variable proportions of alumina, oxide of iron, and water, and treat it with hydrochloric acid. After having ground the clay to a fine powder, and calcined it in a reverberatory or other furnace, he exposes it to the action of hydrochloric acid gas (as it comes from the furnaces in the ordinary plan of making salt cake, or obtained in any other way), care being taken that the temperature of the gas is somewhere about 200° Fahr. If the temperature is too high no action takes place, and if too low the compound becomes partly liquified, which is inconvenient. When the operation has been successfully performed, the resulting substance, which he calls crude chloralum cake, is in a dry state, and consists of a mixture of chloride of aluminium, with chloride of iron, silica, water, and other substances. To purify the crude chloralum cake from iron and free acid, it is kept moderately heated for some time, and a current of air may be passed over it, but this is not essential. By this means all free hydrochloric acid is driven off, and the greater part of the chloride of iron in the cake becomes decomposed, hydrochloric acid being driven off, and oxide of iron remaining. When the chloralum cake is now treated with water, the chloride of aluminium dissolves, but the oxide of iron remains insoluble, and together with the silica is easily separated by filtration or subsidence. By this means an almost pure solution of chloride of aluminium is obtained; it is suitable for the purposes of the dyer or paper maker. A pure entirely soluble solid chloride of aluminium may be obtained from this solution by evaporation, and he prefers sending the material into the market in the state of the purified cake, but for many purposes the separation of the iron would be of no importance, and in that case the crude cake might be used. The solution of chloride of aluminium may be evaporated to dryness and calcined, by which a very pure form of alumina is obtained, suitable for the manufacture of aluminium, aluminate of soda, acetate of aluminium, or any aluminous compound. If this operation is carried on in suitable vessels, and the evolved fumes condensed, a very pure and concentrated form of hydrochloric acid is obtained. The same result can be obtained by calcining the crude chloralum cake, but in this case the residue will contain silica and oxide of iron, in addition to the alumina. The same process for separating iron and free acid is applicable, however the chloride of aluminium may have been obtained.

THE MANUFACTURE OF IRON.

BY LEWIS THOMPSON, M.R.C.S.

One of the most important questions that has of late been brought to the attention of engineers, arising mainly from the greatly increased power of resistance demanded in the materials employed in carrying out the vast schemes for railway and marine propulsion, and in the construction and armament of floating and other batteries, is the mechanical properties of pure iron. To obtain pure iron in a chemical laboratory is almost, if not quite, impossible, unless we are content with a few grains of a dubious metallic powder, formed by passing hydrogen gas over oxide of iron at a red heat. In a practical point of view, pure iron requires for its production a combination of mechanical and chemical processes such as are used in the arts, and without this combination pure malleable iron cannot be had. The buttons obtained in crucibles by chemists are never pure; for the affinities of iron at its melting temperature are so energetic that it will decompose even the silica and alumina of the crucible, and, as I have proved by experiment, decompose magnesia itself, and combine with the reduced substance into an alloy.

There is, however, no difficulty in procuring pure iron in commerce, and here I beg of my readers to accompany me into an enquiry regarding the consequences of purity, or as it is called, "chemical purity." I believe everybody knows that when we wish to obtain a substance in a crystalline form, we endeavour to render it pure by removing from it every other substance; indeed, the word "purify" is synonymous in many instances with the word "crystallise;" thus sugar, salt, soda, borax, alum, and many other things are said to be "purified", when, in fact, they are merely rendered fit to crystallise, the purification being only a means to an end: and this purification is, in a vast number of cases, so essential to the success of the crystallising process, that crystals cannot be procured without it. When an article is pure, it is in that state which is most favourable for crystallisation. Moreover, when an article is quite pure, and placed at rest, it will so remain for an indefinite time without crystallising, until, by the effect of a gentle vibration or other disturbing case, the molecules are set in motion; when they immediately arrange themselves into a crystalline form, under the influence of that gentle force which they have previously resisted, by means of what Newton has called *vis inertiæ*. Now, pure iron will crystallise when placed in such circumstances as I have described, and in crystallising it loses its cohesive force and fibrous nature; it is, therefore, a dangerous substance. To-day it is fibrous, and will resist almost any pressure; to-morrow it may be crystalline, and will give way all at once, like a piece of sandstone.

I should weary out the patience of the most Job-like reader if I were to attempt to narrate one-tenth part of the experiments I have made upon this subject; I will, therefore, describe only two or three. First, however, let us understand each other; by the words "bar or rod of iron," I mean always a rod of the best Swedish iron, ½ in. in diameter; and when I say "continuous vibration," I mean the effect produced by the following arrangement:—A tumbler bucket was so placed as to be kept in motion by a constant stream of water, which filled the two compartments of the bucket alternately, and thus communicated movement to a small hammer, which struck upon the iron bar selected for the experiment, and gave at the rate of 32 blows per minute. The bar could be maintained in either a horizontal or vertical position, and it could either be kept cold, or heated by gas-burners to any degree short of bright redness; moreover, before commencing the experiments, it was found that the bar, when placed with its two ends resting upon supports, bent under the effect of 360 lbs. suspended by a hook from its centre, but did not yield to a weight of 350 lbs. The bar was then placed horizontally in the cold, and subjected to continuous vibration for six weeks; upon trial it broke under a weight of 336 lbs., which was the first weight applied to it; in a second similar experiment the bar broke with a weight of 275 lbs. The bar was next placed vertically in the cold, and in six weeks broke with a weight of 250 lbs.; in a second experiment, tried at the end of only four weeks, it broke with a weight of 267 lbs. This difference between the vertical and horizontal position has been confirmed by a great many experiments, and is, I believe, due to the magnetic influence of the earth, for no such difference takes place when the bar is heated, as shown by the next experiments. The bar was now placed horizontally, and kept pretty uniformly at the boiling point of mercury; in three weeks it broke under a weight of 207 lbs. Placed vertically, under the same circumstances, it broke with a weight of 212 lbs.; in every instance the fractured surface was decidedly crystalline.

I now began to look about for some source of impurity as a means of preventing crystallisation; and here let me disclaim any great merit of originality. The whole thing stands bare and palpable to the eye of anyone who will take the trouble to look at it in the pages of Berzelius's Chemistry, vol. i, p. 368, Brussels edition.—where we find the following words:—"*Le vanadium vient d'etre découvert dans le cours de l'année* 1830, *par Sefstrom, dans un fer suédois, remarquable par sa ductilité extraordinaire.*" Here, then, we find a sample of iron so remarkable for its extraordinary ductility as to induce a chemist to examine it, and he finds that it is impure, and contains a foreign metal, to which impurity its wonderful ductility is due.

But vanadium is a very scarce metal, and, therefore, beyond the range of practical employment. Then, again, there are several conditions to be fulfilled in selecting a proper agent to prevent the crystallisation of iron. In the first place it must not, like manganese or zinc, be a metal which will oxidise, and leave the iron at a red heat; nor, secondly, must it be one like copper, which will create a galvanic circuit, and cause the iron to oxidise under the influence of water or a moist atmosphere. After some consideration and many experiments, I have selected nickel, in the proportion of 1 per cent., as the best antidote to the evil tendency of iron to become crystalline and lose its strength. By nickel I do not mean the heterogeneous compound sold under that name in this country; such stuff would debase any metal. I mean pure, honest nickel; and I use it by adding it to the pig-iron before the commencement of the puddling process, which it appears very greatly to facilitate by burning off the carbon. At all events it remains in the iron, and can be detected, by chemical means, in the resulting bar or wrought-iron. Of course my "continuous vibration" experiments are in favour of such iron, but all this remains to be proved by others before it is worthy of public confidence. The question is, however, of great national importance. We daily see machinery, which has been subjected to a vibratory action, suddenly breaking, and creating dismay and death all around it; and we still more frequently hear of steam-boilers exploding under circumstances where the united force of fire and the vibration of the steam-engine give good ground for supposing that the iron has been made to crystallise and lose its fibrous character by a new molecular arrangement.

If, then, I have said enough to attract public attention to this matter, I have said all that I wanted to say. As to whether I have or have not pointed out a remedy, this is a thing of small importance; for if I have failed in this respect it will not be long before some one else will succeed. The grand object is to attract public attention to the origin of the evil.—*Newton's Journal of Arts and Sciences.*

BITUMINOUS CEMENT.—Certain improvements in the manufacture of bituminous cements have been provisionally specified by Dr. A. Gannal, of Paris. He first dries the earth or sand in the sun, to have it ready when wanted, and to employ it he then heats it on a cast or sheet-iron table, heated to about 251° to 318° Fahr., and afterwards mixes it in a boiler, or on the said table, with melted bitumen. When these substances are well mixed, and the heat has risen to from 366° to 424° Fahr., the cement is formed and ready to be used. But as it could not be spread with the pallet, he makes use of a heated stamper. He lays the cement over the place where it is employed with a trowel, in the same manner as for any other lime cement, and then stamps it with a heated stamper; by this means the cement is settled down closer, and the empty spaces between the various grains of sands are filled up, while the excess in the bitumen is forced to the surface. He powders this part with very fine sand, which agglomerates with the bitumen on the surface of the cement, and to level it he passes over it a light roller or a pallet; gas or resin tar may also be employed, alone or mixed with bitumen. If he employs bitumen, furnishing in the calcination about 24 or 26 per cent. of residue, he mixes 25 parts of bitumen with 100 parts of sand. With bitumen of purer quality the proportion is about 18 parts to 100 parts of sand. This cement can be employed in lieu of the ordinary bituminous cements, and can be advantageously substituted for the betons for buildings, for which the proportion can be reduced to about 8 parts to 100 parts of sand.

GUNPOWDER.—Mr. T. Davey, of Tuckingmill, proposes to treat starch, dextrine, gum, flour, or sugar, with nitric acid, or with nitric and sulphuric acid, the product to be intimately mixed with the ordinary ingredients of gunpowder, and then granulated and finished in the ordinary manner. Or, in place of producing solid grains, he causes the materials when in a plastic state to be forced through dies or moulded to produce tubes or tubular pieces in place of solid grains, and such tubes may be of dimensions suitable to fit the bore or cavity in which they are used, or the tubes may be of small diameter, and used in quantities as solid grains have heretofore been used in making up charges. By this means the quantity of saltpetre or nitrate of soda ordinarily employed may be reduced. In some cases in order to lessen or replace the sulphur employed, he uses paraffin, petroleum, turpentine, naphtha, or other suitable hydro-carbon.

NEW WATER-PRESSURE ENGINE.—Among the many problems that Science offers to her votaries for solution, few have attracted more attention than the possibility of superseding steam power by that of water. Motion is easily communicated through or by means of water, but the difficulties in the way of its application in order to take the place of steam must, at first sight, and especially to those well acquainted with hydraulic operations, appear almost insuperable. They have, however, by a comparatively simple mechanical arrangement, been overcome, and, within the last few days, we have seen at the Waterworks Office, in this town, an hydraulic engine doing the work of a steam-engine in the most complete and satisfactory manner. It is the invention of Mr. Henry James Lewis, a practical engineer, and from the advantages it possesses we cannot doubt that it will come into extensive use. Its mechanism in appearance is much the same as that of the steam-engine, with the exception that it has two globes or air-vessels upon the cylinder. The action is very simple. The water is supplied to the engine from the main by means of an ordinary pipe, and can be turned on or off by means of a common stop-cock at pleasure. When the engine is about to be set to work the water is allowed to pass into a chest or nozzle, within which is a slide-valve, the same as is used in a steam-engine. The water, having filled the nozzle, rushes through the passage that is not covered by the slide-valve into the cylinder, forcing the piston along with it, at the same time compressing the air in one of the globes or air-vessels that we have before mentioned, until the side-valve shuts the passage; when the air that is now compressed in the one globe, by giving a certain amount of elasticity to the water acting on the piston, enables the crank to continue its motion. After the valve has covered the one passage, preparatory to opening the other passage for the future stroke of the engine, the same process is repeated. The rectilinear motion is converted into a rotatory motion by means of a connecting-rod and crank, and applied to the purpose for which it is required by ordinary pulley bands. The power is, of course, capable of increase according to the size of the engine; but it seems to us best adapted for work for which small steam-engines are employed. The advantages attending the water-pressure engine are great. It can be used wherever water is supplied from the main with expedition and ease, nothing more being required to set it at work or to stop it than to turn the stop-cock. No boiler nor boiler fixings are required, and there is, of course, perfect freedom from the danger of explosion. It requires no attendance or supervision while at work, and may be worked at the shortest intervals, or for hours consecutively as occasion may require. The water, too, is as pure after it has passed through the engine as when it entered, and may be immediately used, or retained, or re-distributed as required. The cost of the engine is comparatively small; while the charge for water will be much less than that incurred

in the case of steam-engines for coal and attendance. An engine possessing such advantages as those we have mentioned, and of such extensive applicability, cannot fail, we think, to come into general use.—*Wolverhampton Chronicle.*

SOLID-DRAWN IRON AND STEEL TUBES.

The many purposes to which cheap and reliable iron and steel tubes could be applied are so well known that it is quite unnecessary to refer to them—boiler-tubes, hollow axles, hydraulic pipes, hollow taps, surface condensers, piston-rods, steel collars, and gas piping being but a few of the articles for which they could be substituted for those now employed. Such being the case, it is concluded that an invention that admits of tubes of almost any length and diameter being drawn from the cold metal, and of a quality capable of being used even for gun barrels, could not fail to prove remunerative to those developing it; a company has, therefore, been incorporated under the Companies Act, 1862, with limited liability—the Solid-Drawn Iron and Steel Tube Company—with a capital of 150,000*l.*, in shares of 5*l.* each, for purchasing and developing certain patents for the manufacture of iron and steel tubes without join or weld, in a rapid and most economical manner, and of any shape, size, and length within the ordinary limits of mechanical force.

The advantages claimed for the invention are really marvellous. The tubes being drawn cold, and without any action of fire, an enormous saving results in the metal; thus, by this process, two Enfield rifle barrels of the standard size, weight, and strength can be drawn from the piece of metal now consumed in the manufacture of one barrel, whilst the process is so inexpensive that an Enfield rifle barrel of the present kind can be produced for less than one-half the present cost, and a steel barrel of like length and dimensions for the present price of iron ones. The proofs to which the new cold-drawn steel gun barrels and tubes have been submitted establish, beyond doubt, the fact that the metal employed is of excellent quality, and that the mode of manufacture is thoroughly applicable to all the purposes to which it has been applied. The privileges to be purchased by the company include not only the processes for manufacturing the tubes, but the monopoly of the peculiar steel from which those tubes can be made, and which is superior to any at present known to commerce. It is intended, in the first instance, to erect a small factory to prove the invention, and to grant licenses to manufacturers upon terms that will aid rather than conflict with existing interests.

The terms upon which the patentees agree to transfer to the company all their patents for the United Kingdom is 10,000*l.* cash, and 20,000*l.* and a royalty upon the dividends paid by the company during the continuance of the patents; but, as a proof of their confidence in the eventual success of the patent, they agree to forego all payment until after the satisfactory trial of the machinery in London, and to take neither dividend nor royalty until 10 per cent. has been paid on the first issue of 75,000*l.* of capital. The severity of the proofs to which the gun-barrels have been put leave no doubt whatever as to the reliance which can be placed upon the invention—at Paris results were obtained which secured the unequivocal approbation of the military engineers and gunsmiths who assisted at the experiments; at Birmingham the barrels stood more than double the ordinary proof charge without being affected; and at the London Proof House the tests were equally satisfactory. The direction of the company comprises the names of gentlemen well known in connection with commercial affairs; and, as no payment beyond the deposit of 10s. per share is to be made until the value of the invention is proved, considerable inducements are offered to capitalists.

THE TIN TRADE.

The movement in the article during the past month has again been important, and the transactions very large. The reason has been that the supplies of both Banca and Straits continue to fall off in such a way as to excite attention on the part of consumers, as well as speculators; and both parties coming into the market together have given an impetus to prices. The accounts from Singapore and Penang advise a continued demand for China, and, consequently, no shipments to Europe. One vessel only is loading at Penang for London; she will bring about 80 tons. The quantity of Banca tin now afloat from Java to Holland is only about 33,000 slabs, so that, should all this arrive in time, we cannot expect a sale of over 120,000 slabs against 155,000 last year, 149,188 in 1861, 151,513 in 1860, 139,129 in 1859, 190,842 in 1858, and 190,559 in 1857. The deliveries of Banca last month were rather in excess of last year. The deliveries of foreign tin from London have been small, and has, undoubtedly, been caused by the comparatively cheaper price of English, which still continues, though not so great in extent as during the earlier part of the month; the stock of English in smelters' hands must have diminished. The quantity of tin here and in Holland on Feb. 28 was as follows, compared with the three preceding years:—

	1863.	1862.	1861.	1860.
	Slabs. Tons.	Slabs. Tons.	Slabs. Tons.	Slabs. Tons.
Stock in Holland	51,740=1610..	40,401=1250..	50,945=1580..	44,643=1380
Arrived towards next sale.	86,234=2680..	103,876=3225..	120,746=3740..	87,704=2720
Stock here	2489	1573	610	880
Total tons	6779	6084	5930	4980

The quantity of Straits now on passage to Great Britain is 323 tons, against 833 tons last year.—ENGLISH TIN: A large business was done previous to the advance of 4*l.* per ton, which was declared by the smelters on Feb. 24, and since then but little has been done.—STRAITS: The transactions amount to 20,000 slabs; early in the month it stood at 121*l.* cash, and at this price large purchases were made, and at 121*l.* to arrive, and three months prompt: from this the market advanced from 121*l.* cash to 122*l.* 10s. three months prompt, and a parcel to arrive has been reported 123*l.* The market is now firm at full prices.—BANCA: The transactions amount to about 12,000 slabs, at from 121*l.* to 123*l.* cash, and 122*l.* to 124*l.* three months prompt. The Dutch market has been active, and the prices have advanced from 70 fl. to 73 fl.

The official returns from Holland are as follows:—

	1863.	1862.	1861.
Stock on warrants, Feb. 1	Slabs 60,405	48,866	61,011
Delivered during February	8,665	8,465	10,157
Stock on warrants, March 1	51,740	40,401	50,954
Arrived towards next sale	86,234	103,876	120,746

The arrivals of tin in London during February were as follows:—Straits, per *Niassa*, 3114 slabs; ditto per *Pilgrim*, 709; Banca, from Holland, 3705=7618 slabs.

Making since Jan. 1 into London:—	1863.	1862.	1861.	1860.
Banca	Slabs 4,555	1,058	——	1,665
Straits	6,674	18,927	11,792	14,346
Total	11,229	19,975	11,792	16,011

We estimate the present stock of tin in warehouse here at 2489 tons, against 2513 tons a month.

The import and export of tin during the month of December last, and the year end-1862, compared with 1860 and 1861, have been as follows:—

	Month ending Dec. 31.			Month ending Dec. 31.		
	1860.	1861.	1862.	1860.	1861.	1862.
Import....cwts.	10,272	20,683	20,311	58,220	73,062	87,873
Export—Foreign	845	2,590	825	10,163	19,173	21,668
English	4,440	3,364	6,562	54,811	56,673	61,913

No shipments of tin have been made from either Singapore or Penang from Dec. 24 to Jan. 24. Price in Singapore, $29¼; in Penang, $25¾.

TIN-PLATES.—There has been a fair demand during the past month for all parts but America; operators for this quarter are giving out but few fresh orders. In charcoal, prices are depressed, while for coke full quotations are paid. The declared value of tin-plates exported during December, and the year ending 1862, compared with 1860 and 1861, has been as follows:—

Month ending Dec. 31.			Month ending Dec. 31.		
1860.	1861.	1862.	1860.	1861.	1862.
£100,030	£90,126	£72,312	£1,500,812	£907,947	£1,211,081

VON DADELSZEN AND NORTH.

PRICES OF MATERIALS,

As charged at the PROVIDENCE MINES during the following months:—

Description.		Oct.	Nov.	Dec.
Common iron	per cwt.	7s. 6d.	8s. 0d.	—
Hoop iron	"	13 0	—	—
Best cast steel	"	50 0	50 0	—
Blister steel	"	50 0	—	—
Nails, 5 inch	"	19 0	—	—
Nails, 4 inch	"	—	—	19s. 9d.
Nails, 3¾ inch	"	20 0	—	20 0
Nails, 3 inch	per 1000	—	—	4 7
Best chain, 9-16	per cwt.	—	26 6	—
White lead	"	34 0	—	—
Bendhide Leather	per lb.	2 3	—	—
Longsound timber	per foot	0 8	0 10	0 10
Yellow pine ditto	"	—	1 4	—
M. C. Coals (contract)	per ton	10 10	11 0	11 4
Best candles (carriage free)	per doz	5 9	5 6	5 6
Tallow (ditto)	per cwt.	51 0	48 6	—
Olive oil (ditto)	per gal.	—	—	5 6
Fowder (ditto)	per 100 lbs.	50 0	—	50 0
Safety-fuse (ditto)	per coil	0 4	0 4	0 4
Rope (ditto)	per cwt.	—	—	44 0
Hilts (ditto)	per doz.	—	1 10	—

THE LAW OF MINES.—The new work on the Law of Mines, by Mr. Whitton Arundell, the only cheap book in which the entire subject is completely and ably handled, and no work can be more profitably studied, after the company is formed, than this. The law of mines is in this work treated quite irrespective of the law of mining companies, which are entirely governed by the new Joint Stock Companies Act of 1862. Mr. Arundell's work will be forwarded from our office on receipt of a Post-office order for 4s.

BY HER MAJESTY'S ROYAL LETTERS PATENT.

GEORGE SPILL & CO.'S IMPROVED MACHINERY BELTING,
WARRANTED NOT AFFECTED BY HEAT, WATER, OR GREASE, AND ARE MADE TO ANY LENGTH IN ONE PIECE.
PRICES PER FOOT RUN.

Inches wide.	1	1½	2	2½	3	3½	4	4½	5	5½	6	7	8	9	10	11	12
No. 1 substance.	0 3	0 4	0 6	0 7½	0 9	0 10½	1 0	1 1½	1 3	—	—	—	—	—	—	—	—
No. 2 substance.	—	—	—	—	1 3	1 4½	1 6	1 7½	1 9	1 10½	2 0	2 3	2 6	2 9	3 0	—	—
No. 3 substance.	—	—	—	—	—	—	1 9	1 10½	2 0	2 3	2 6	3 0	3 6	4 0	4 6	5 0	5 6

This Belting (unlike the ordinary manufactures) is woven into one solid substance from the best flax yarn, and are saturated with a compound to consolidate them, which not liable to decomposition. They possess extraordinary strength, as the following certificate will verify, which renders them particularly adapted for paper and saw mills, threshing machines, grain elevators, foundries, machine shops, &c.

COPY OF CERTIFICATE, FROM THE PORT OF LONDON CHAIN CABLE PROOF HOUSE.

THIS IS TO CERTIFY, that the tensile strength of Machinery Belting, manufactured by GEO. SPILL AND CO., of HACKNEY WICK, LONDON, as proved by my chain cable testing machine, at Rotherhithe, to be as follows, viz.:—

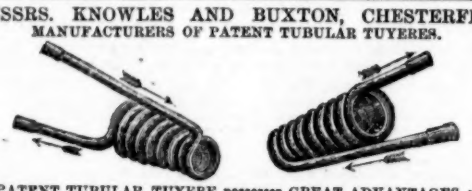
No. 1 substance	5 in. wide, broke at the strain of	6,272 lbs., or, for every inch of width,	1254 lbs.
No. 2	5 in. wide,	7,448 lbs., or, for every inch of width,	1489 lbs.
No. 3	10 in. wide,	16,632 lbs., or, for every inch of width,	1663 lbs.
A stout leather band	4 in. wide,	2,100 lbs., or, for every inch of width,	525 lbs.

July 9, 1862. (Signed) WM. MITCHESON.

Manufacturers of India rubber. Double texture and oiled waterproof cart, rick, and wagon sheets, made up ready for use, price at per square yard. Farmers' gaiters, buskins, and farm labourers' waterproof garments. WORKS, HACKNEY WICK, N.E.;

DEPOT, 149, CHEAPSIDE, E.C., LONDON, AND 9, HIGH STREET, BRISTOL.

MESSRS. KNOWLES AND BUXTON, CHESTERFIELD,
MANUFACTURERS OF PATENT TUBULAR TUYERES.



The PATENT TUBULAR TUYERE possesses GREAT ADVANTAGES over the ORDINARY TUYERES, both for its DURABILITY and EASY WORKING. A current of cold water going direct to the nozzle prevents their destruction, however much they may be exposed to the fire.

We repair them at half the first cost, making them equal in size to new ones, all parties returning them carriage paid.

No. 1 tuyere,	16	in. long		28s. each.
No. 2	18	"		32s. "
No. 3	20	"		36s. "
No. 4	22	"		40s. "
No. 5	24	"		44s. "

Delivered at Chesterfield station. Terms, nett cash quarterly.

PUBLIC TEST OF WIRE-ROPE.—The SUPERIOR QUALITY of GARNOCK, BIBBY, AND CO.'S WIRE-ROPE was FULLY PROVED by a RIVAL MANUFACTURER at the LIVERPOOL PUBLIC TESTING MACHINE, on the 29th of October, 1860, on which occasion GARNOCK, BIBBY, and Co.'s ropes were found to be the STRONGEST o all the TWELVE SAMPLES from different makers then tested, as reported in the papers of the day. For example:—

(Certified by Mr. William Macdonald, superintendent.)

Sizes.	Garnock, Bibby, and Co. Tons c.	Corresponding sizes from other manufacturers. Tons c.
3¼ in.	18 5*	16 10 ..... 11 10
2½ in.	8 15*	7 15 ..... 5 0

Remaining sizes with similar results.

* Samples taken promiscuously from stock by a rival manufacturer's agent.

GARNOCK, BIBBY, AND CO.,
SWAN HEMP AND WIRE ROPE MANUFACTURERS,
LIVERPOOL.

FLAT and ROUND STEEL and IRON WIRE ROPES for MINES, &c., of SUPERIOR QUALITY.

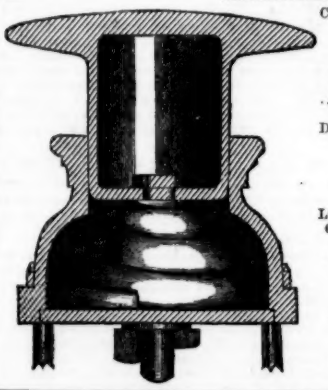
BARCLAY'S PATENT STEAM AND WATER PRESSURE AND VACUUM GAUGES.

These GAUGES are MADE to INDICATE ANY PRESSURE from ONE to TWENTY THOUSAND POUNDS upon the SQUARE INCH.

EACH GAUGE is GUARANTEED FOR FIVE YEARS.

PATENTEE AND MAKER,
ANDREW BARCLAY,
ENGINEER,
KILMARNOCK.

THOMAS TURTON AND SONS,
MANUFACTURERS OF



CAST STEEL for PUNCHES, TAPS and DIES, TURNING TOOLS, CHISELS, &c.
CAST STEEL PISTON RODS, CRANK PINS, CONNECTING RODS, STRAIGHT and CRANK AXLES, SHAFTS and FORGINGS of EVERY DESCRIPTION.
DOUBLE SHEAR STEEL, BLISTER STEEL, SPRING STEEL, GERMAN STEEL.
Files marked "T. TURTON."
Edge tools marked "WM. GREAVES AND SONS."
LOCOMOTIVE ENGINE, RAILWAY CARRIAGE & WAGON SPRINGS and BUFFERS.
Illustrated catalogue, with prices, forwarded on receipt of twelve stamps.

SHEAF WORKS AND SPRING WORKS, SHEFFIELD.
LONDON OFFICE.
17, KING WILLIAM STREET, CITY, E.C.

Prize Medals—International Exhibition, Class 1 and 2.

PATENT PLUMBAGO CRUCIBLES.—The CRUCIBLES manufactured by the PATENT PLUMBAGO CRUCIBLE COMPANY are the ONLY KIND for which a MEDAL has been AWARDED, and are now used exclusively by the English, Australian, and Indian Mints; the French, Russian, and other Continental Mints; the Royal Arsenals of Woolwich, Bres t and Toulon, &c.; and have been adopted by most of the large ENGINEERS, BRASSFOUNDERS, and REFINERS in this country and abroad. The GREAT SUPERIORITY of these melting pots consists in their capability of melting on an average 40 pourings of the most difficult metals, and a still greater number of those of an ordinary character, some of them having actually reached the EXTRAORDINARY NUMBER of 96 meltings. They are unaffected by change of temperature, never crack, and become heated much more rapidly than any other crucibles. In consequence of their great durability, the saving of waste is also very considerable.

The company have recently introduced CRUCIBLES SPECIALLY ADAPTED for the following purposes, viz.:—MALLEABLE IRON MELTING, the average working of which has proved to be about seven days; STEEL MELTING, which are found to save nearly 1¼ ton of fuel to every ton of steel fused; and for ZINC MELTING, lasting much longer than the ordinary iron pots, and saving the great loss which arises from mixture with iron.

For lists, testimonials, &c., apply to the Patent Plumbago Crucible Company, Battersea Works, London, S.W.

Fully described in the MINING JOURNAL of July 5.

BASTIER'S PATENT CHAIN PUMP.
APPARATUS FOR RAISING WATER ECONOMICALLY, ESPECIALLY APPLICABLE TO ALL KINDS OF MINES, DRAINAGE, WELLS, MARINE, FIRE, &c.

J. U. BASTIER begs to call the attention of proprietors of mines, engineers, architects armers, and the public in general, to his new pump, the cheapest and most efficient ever introduced to public notice. The principle of this new pump is simple and effective, and its action is so arranged that accidental breakage is impossible. It occupies less space than any other kind of pump in use, does not interfere with the working of the shafts, and unites lightness with a degree of durability almost imperishable. By means of this hydraulic machine water can be raised economically from wells of any depth; it can be worked either by steam-engine or any other motive power, by quick or slow motion. The following statement presents some of the results obtained by this hydraulic machine, as daily demonstrated by use:—

1.—It utilises from 90 to 92 per cent. of the motive power.
2.—Its price and expense of installation is 75 per cent. less than the usual pumps employed for mining purposes.
3.—It occupies a very small space.
4.—It raises water from any depth with the same facility and economy.
5.—It raises with the water, and without the slightest injury to the apparatus, sand, mud, wood, stone, and every object of a smaller diameter than its tube.
6.—It is easily removed, and requires no cleaning or attention.

A mining pump can be seen daily at work, at Wheal Concord Mine, South Sydenham, Devon, near Tavistock; and a shipping pump at Woodside Graving Dock Company (Limited), Birkenhead, near Liverpool.

J. U. BASTIER, sole manufacturer, will CONTRACT to ERECT his PATENT PUMP at HIS OWN EXPENSE, and will GUARANTEE IT FOR ONE YEAR, or will GRANT LICENSES to manufacturers, mining proprietors, and others, for the USE of his INVENTION.

OFFICES, 47, WARREN STREET, FITZROY SQUARE.
London, March 21, 1859. Hours from Ten till Four. J. U. BASTIER, C.E.

MINES AND MINING.

STATISTICS OF AND OBSERVATIONS UPON THE MINES OF CORNWALL AND DEVON.

Illustrated by Maps, Plans, and Sections of the Principal Mining Districts in the two counties. By Mr. THOMAS SPARGO,

Mining Engineer, Stock and Sharebroker, Gresham-house, Old Broad-street, London.

It contains detailed particulars of the indications and prospects of all the important mines in the two counties, with annual statistical returns, and dividends paid by each; sections and diagrams of the most productive districts, with explanatory notes upon each; as also a map of Cornwall, showing its area and population.

OPINIONS OF THE PRESS.

The mine proprietors of the Western counties have good reason to congratulate themselves that so able an advocate of British Mining as Mr. Thomas Spargo has devoted his energies to the extension of mining literature; while capitalists embarking in mine adventure will thank him for placing requisite and very desirable knowledge so immediately within their reach. Under the title of "The Statistics of and Observations upon the Mines of Cornwall and Devon," Mr. Spargo has issued a manual of statistics and instructive details which cannot fail to be useful to those seeking information. That his explanations may be more readily comprehended, he has illustrated his work with a series of very neatly executed maps of the several mining districts to which he refers.—*Mining Journal.*

The work altogether forms an acceptable addition to the existing stock of mining literature, and may be commended to the attention of those who wish to extend their acquaintance with this branch of our home industry.—*Daily News.*

Mr. Spargo's "Statistics of and Observations upon the Mines of Cornwall and Devon" deserves to be perused by all parties who are interested in these investments, and the facts and opinions presented appear to be stated in a fair and candid manner.—*Herald.*

Mr. Spargo's Statistics is full of information useful to parties associated either practically or commercially with mining undertakings.—*Star.*

An instructive publication, deserving of every encouragement.—*Daily Telegraph.*

We recommend this work as a guide to the mines of Cornwall and Devon.—*Chronicle.*

The pamphlet is worthy the attention of all engaged in mining speculations.—*Post.*

It contains in a compressed, but still comprehensive form, all the information requisite to guide an adventurer in the selection of mines for legitimate investment.—*Welshman.*

From these the mining speculator may arrive at a correct judgment on all mining undertakings.—*Shropshire Conservative.*

No adventurer should enter upon any mining undertaking until he has carefully studied this pamphlet. He will find it a true guide when seeking for a profitable investment.—*Durham County Advertiser.*

A work of rare merit, filled with original matter, concise but comprehensive, and will be found of inestimable value to parties desirous of investing capital in mining undertakings.—*Doncaster Chronicle.*

A guide to safe investments, and should be consulted by an intended investor before purchasing shares in any mining undertaking.—*Cheltenham Chronicle.*

It contains accurate information upon all points demanding consideration, and as the work of a practical miner may be confidently relied upon.—*Devonport and Plymouth Telegraph.* [*Chester Courant.*

This work will prove of great utility to all who are concerned in mining operations.—

This little work is of inestimable value to all persons interested in the mining operations of the country.—*Blackburn Times.*

We earnestly recommend the consideration of Mr. Spargo's book to all mining speculators.—*Hereford Journal.* [*Evening Post.*

This work should be read by every man interested in mining adventures.—*Edinburgh*

An excellent practical treatise upon an important staple of our commerce, the mines of Cornwall.—*Langport Herald.* [*Courier.*

We recommend this pamphlet to the attentive consideration of our readers.—*Halifax*

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